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HORSES AND RIDING.

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FARMS AND FARMING

BY

GEORGE NEVILE, M.A.

AUTHOR OF

'HORSES AND RIDING'

WITH ILLUSTRATIONS by THE AUTHOR

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PREFACE.

In treating of a subject so thoroughly threshed out, so to speak, as Farming, it is difficult to lay claim to originality. The most that any one writing on Agriculture can do is to collect and condense the results of the various experiments and researches that have, from time to time, been made, and present them to the public in an assimilable form. There has hardly been a time when the Agricultural Industry of this country—the greatest industry of one of the greatest nations in the world—has stood more in need than it does at present of some stimulus to preserve it from decay. Partly from a few bad seasons and partly from the unequal pressure of taxation, which inequality is beginning now to be realised by others than those engaged solely in Agriculture, the home production of food has been diminished, and capital and enterprise have been

diverted to other branches of industry to an unusual extent. The object not only of those immediately interested in farming, but of all who have the welfare of their country at heart, should be to endeavour to bring it back. No nation can be in a healthy state, or exist at all for a very lengthened period, which draws its means of subsistence from foreign countries, while its own land is lying unproductive at home.

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PART I.

CHAPTER I.

RELATION OF CAPITAL REQUIRED TO LAND.

Up to quite recently it has been almost everywhere in this country the exception, and not the custom, for owners of land—at least in any quantity approaching the size of what is called an estate—to conduct the agricultural operations carried out on the land themselves, that is, to keep their land in their own hands, with a view to obtaining their income in this manner.

It is quite true that on many estates one of the farms may be held by the owner, but it has generally been either for amusement or for the sake of trying experiments, or for convenience of having a dairy of his own, or, in fact, for any reason rather than that of obtaining an income.

This is not at all the case in other countries. In Denmark and Austria large tracts of land are worked by their owners; and the system of letting farms as practised in England is the exception, and not the rule.

The reason of this custom, so universally prevailing in this country, is probably to be found in two things: first, that when a man can get an income

sufficient for his requirements without taking any trouble, it is difficult to get him to take any, even though the trouble he took would repay him by conferring on him a larger income than he previously enjoyed.

Secondly, that in nine cases out of ten in this particular instance, it happens somehow that when he does make the effort and take the trouble, he finds that he has diminished his income instead of increasing it, and this induces the man who has tried it to abandon the attempt without taking any great pains to ascertain the reasons of his failure, and deters others from following his example.

Into the first of these causes, the dislike to take any trouble, I do not propose to enter, as it is a matter for each man's own consideration; but as regards the second cause, the failure to make farming answer when attempted by the owner, I wish to offer a few remarks as to the possible causes of failure. To begin with, people interested in the matter do not, I think, as a rule, sufficiently realise the great difference between an owner of land who has it to let, and a farmer who has it to take.

The owner, simply as an owner, has so many acres of land from which to get an income, and has no money. The farmer who wishes to take the land has so many thousands or hundreds of pounds, as the case may be, and has no land.

In both cases the object is to make an income,

but the materials which each has to set about it are not only widely different, but are pretty much the exact opposites of each other.

Does it not strike any impartial person that the materials with which the two go to work being opposite to each other, it cannot be right for each to start in exactly the same manner? or, to put it as it happens in practice, for a man who has land and no money to set to work in precisely the same manner as the man who has money and no land? To begin with the man who has a certain sum of money and a knowledge of farming; this man has, so to speak, all his money for nothing, but has to hire, that is, pay for, every acre of land on which he conducts his operations.

It is evident here that what is best for him is to pay for as little land as he can employ his capital profitably upon, and that if he can earn as much interest on his capital by farming two hundred acres as he can by farming three hundred acres of the same sort of land, then, in that case, all the money he pays for the hire of the extra hundred acres is lost to him.

We will now take the case of a man who finds himself in possession of a certain number of acres of land only. In this case his object is to get a certain income out of his land, and as he has to hire, that is, pay for, all the money which he requires to have to enable him to obtain the income from the land, it

stands to reason that if he can obtain a certain income from his land by the help of a certain sum of money, then every halfpenny he pays for the use of any money *beyond* this sum is a dead loss to him, and diminishes his income by so much.

The result we arrive at by comparing these two considerations is, that an owner of land ought to try and farm his land with the least possible capital which will enable him to do so, and that a tenant or man who has to rent the land ought to try and farm with his money on the least possible quantity of land; or to put it conversely, the tenant ought to apply as little land to his money, that is, as much money to each acre, as he can; and the landowner ought to apply as much land to the money he has to employ, that is, as *small* a sum of money per acre as he can.

It is obvious, when this difference is taken into account, that what is the right thing for the one to do cannot always be exactly the right thing for the other to do; and that the mode of farming pursued by one party with advantage and profit may easily end in loss and disappointment to the other.

CHAPTER II.

ON THE CLASSIFICATION OF PLANTS USUALLY CULTIVATED IN ORDINARY HUSBANDRY.

THE plants usually cultivated in agriculture are generally divided into four different species—the bulbous, the leguminous, the cereal, and the graminaceous. Turnips, swedes, mangolds, beetroot, parsnips and carrots, belong to the first. Beans, peas, tares, Kohl-Rabi, cabbages, kale or rape, mustard, and red and white clover belong to the second. Wheat, barley, oats, and rye to the third, and the greater number of grasses to the fourth. There is another class of vegetable, the potato, which differs in its habits from all those I have enumerated, but may, I think, for convenience be classed among the leguminous plants as far as similarity of cultivation is concerned.

Of these all the first class are biennials, forming the bulb one year and the seed the next.

Of the leguminous plants, beans, peas, tares and mustard are annuals, producing their seed within a twelvemonth. Kohl-Rabi, cabbage, and kale or rape are biennials, and red and white clover go on a longer

period, white clover being perennial. Of the cereals the whole are annuals, and of the greater number of the graminaceous plants the habits of many are practically unknown, but many of them appear to be perennial.

CHAPTER III.

ON THE FOOD OF PLANTS.

We now come to the consideration of those substances which are absorbed by the vegetable kingdom, and which go to form their structure, and which have not improperly been termed the food of plants. This branch of study has of late years occupied a good deal of the attention of experimenters and investigators, and a very interesting study it is. Half a century ago comparatively little or nothing was known about it. Farmyard manure was the ingredient principally used in raising the crops, and it was found to have a beneficial effect on all sorts of soils, and to be suitable for all kinds of plants.

But as people began to want to spend more money, they began to want to grow larger crops, and to find some material which would enable them to do so, and this brought the subject of manuring or fertilising the soil under the notice of experimental and scientific chemists. First one substance, then another, was discovered, which was found when applied to the

land to have partially the same effect as farmyard manure; in some cases the effect was produced on particular soils, and in some cases on particular kinds of crop; but in both cases the result was to increase the yield of the produce, and so far to increase the gross receipts of the farmer, and to increase the letting value of land by making agriculture more profitable apparently, and therefore more attractive. As scientific investigation proceeded, it was found that certain raw materials could be manufactured into manures of more efficacy than the raw material in its natural state; thus bones could be crushed or dissolved, coprolites could be ground to powder, and potash could be obtained from other substances which contained potash, but which were not available as manure, while the various substances could be mixed together with advantage. This was found to be a lucrative undertaking, and presently the whole face of the country became dotted over with manure manufactories, looking as if it had a fit of the small-pox. But the subject was only very imperfectly understood, the farmers knew little or nothing about what they were buying, and events have proved that the wholesale manufacturing of artificial manure has tended more to enrich the manufacturers of it than the purchasers of it, and that the agriculturists are not much better off than they were before.

The raw materials were for the most part right, and the knowledge of them was right as far as it

went, but the outlay had been too great to leave any profit for all the parties interested. Some of the materials supposed to have a direct fertilising effect were found only to discount the natural fertility of the soil, and while they caused the land to bear a large crop the first year, rendered it less able to bear another crop the following year, and got to be condemned by many as mere stimulants, and not as plant food at all.

I will endeavour in this chapter to carry my readers on up to the present stage at which the knowledge of the laws affecting plant food has arrived, and point out to them the conclusions which may, I think, fairly be drawn from the investigations that have hitherto been made.

The first step then that was taken by experimental chemists was to analyse the plants, and to resolve them into the materials of which they were constructed. This was a right step to begin with. They then deduced from this that the plant was produced by obtaining, or feeding on, these substances. This was also right. They next went a step further, and concluded that the proper way to proceed was to supply the plants artificially with the materials found in them, and to supply them in the proportion in which they were found. *This was wrong*, and events proved it to be so. Plants were supplied with a material of which they were known to contain a large quantity, and the part of the crop where this material

was put on was found to be no better than the rest of the field. In other cases a quantity of a substance known to be required by the plant was applied, and the only result was that the plant grew up less adapted for the purpose for which it was wanted than before.

Clover, for instance, when its contents were analysed, was found to contain large quantities of nitrogen, and was in consequence supposed for some time to be a plant which exhausted the soil of nitrogen. Dr. Voelcker, however, instituted a series of experiments which showed that clover, instead of exhausting the soil of nitrogen, replenished it, and that when a crop of clover was allowed to grow for hay and then taken away altogether, it left more nitrogen in the soil than if it was eaten bare; and that instead of supplying the ground artificially with nitrogen when you wanted a crop of clover, you ought rather to grow a crop of clover when you wanted to supply the soil with nitrogen, the reason being that clover absorbed more nitrogen from the air than it took from the ground, and left more in its roots than it had taken from the soil. Again, in the case of turnips they were found to contain both phosphorus and nitrogen, but the effect of supplying the plant artificially with nitrogen was to diminish the size of the bulb, and consequently reduce the value of the crop.

From a number of experiments bearing similar results, an opinion was arrived at that certain sub-

stances acted as food for certain classes of plants, and that they required little or none of the other substances. Mons. Ville was the exponent of this theory, and proved his case, as he thought, by exhausting of fertility the soil in which he tried his experiments; but he did not go far enough to prove his case as he *wanted* to prove it, for in order to do so he ought to have exhausted the atmosphere of its fertility also. He thought at one time that he had proved conclusively, for instance, that the leguminous plants required principally potash, and little or no nitrogen for their development, whereas if he could have tried to grow them in an atmosphere void of nitrogen, he would have found that they would not have grown at all; and that so far from nitrogen not being so necessary to their welfare as potash, this class of plant required the former just as much as the latter, and in much greater quantities. Again, wheat will grow freely on fertile land if supplied with nitrogen alone, and will yield a much greater quantity of grain than when not so supplied, and this led him to think that the wheat plant required nitrate more than phosphorus; but let anyone try the experiment of supplying the wheat plant with nitrogen only, on soil that contains no phosphorus, and he will meet with a dead failure, whereas if he supplies a good quantity of phosphorus as well, he will obtain a good crop.

The true state of the case, I take it, may be summed up as follows:—

1. There are certain substances which form the nourishment, and are required for the support, of all plants.

2. That although these substances are all to be found in the earth or the air, still some plants have not the same capacity for gathering them as others, and the same plant can supply itself with some of the substances contained in the air and the earth better than it can with the others.

3. That the different substances required for the nourishment of any plant go to build up different parts of its structure respectively.

Taking the first of these it will, I think, be found that all plants require phosphorus, nitrogen, and potash, and that each of these substances is as necessary as the other to the full development of the perfect plant; but the second and third conditions indicate the reasons why the application of one of these substances is attended with a better result than the application of another in the case of different plants. Thus, by studying the second condition, we find that it is advisable to supply phosphates on all soils to plants whose roots are feeble, and whose leaves are broad and strong, even if the land contains a fair share of phosphorus.

It is advisable to supply nitrogen to plants whose leaves are small and narrow, and whose roots are vigorous and branching. It is advisable to supply potash to all plants on soil that is deficient in potash,

for reasons which will be given below in considering the third condition.

The way to find out the action produced by the three different substances above mentioned on any individual plant is to supply that plant with all three, but with a large excess of one of them. If this be done, we shall find that in the case, for instance, of wheat, if we supply an excess of nitrogen to land containing potash and phosphorus, we obtain an increased quantity of grain, that is, seed; and we also find that if we apply nitrogen to soil absolutely without potash and phosphorus, the wheat will not grow. Putting these two together, we arrive at the conclusion that nitrogen is no more a food of the whole wheat plant than the other two; but that when applied in excess under conditions favourable to the growth of the whole plant, it produces more seed, that is, more grain; and as grain is what we want to get from the wheat plant, it is the right manure to give in excess to that plant.

We will now take a totally different plant—the turnip. If we supply this plant with potash and phosphorus in small quantities, and nitrogen in large quantities, we shall, as in the case of wheat, get a large development of flower and seed; but as this is not what we want, we must try something else. We will try phosphorus. If we start with a soil containing a fair quantity of potash, in an atmosphere containing nitrogen, and grow turnips with a large excess of

phosphorus, we find that we get a very large root or bulb, with little leaf, and little or no tendency to produce seed the first year. The effect, therefore, of treating a turnip with an excess of phosphorus is to enlarge the bulb; and as this is what we want, phosphorus is found to be the right manure to apply in excess to this crop.

We will now take a third class of vegetable—the leguminous. These may be said to be required for the leaf and stalk; and it has been found by experiment that a larger proportion of potash is found beneficial in these crops than in the other two, and as far as the third condition is concerned, an excess of potash will give the best results. But in this class of vegetables the second condition comes into play also, for of two plants, both leguminous, one may have a large, broad leaf and a small root, as the cabbage, and another a smaller leaf and wider-spreading root, as the clover. In this case the plant wants supplying with two out of the three substances in excess of the other. It will be found, however, in practice that these crops can be increased in amount in the readiest manner by increasing the quantity of all three ingredients without altering the proportion.

Thus we arrive at the rule that there is no special food required by one plant more than another, but that we ought to apply that substance in excess which forms the root in the case of those plants which we grow for their roots; we should apply that substance

in excess which forms the *seed*, when we want to *obtain* seed, and that where we wish to develop the whole plant, stalk, leaf, flower, and root, as in the case of the clovers, we should apply proportionate quantities of all three, and increase the quantities of all three, *pari passu*—that is, in an equal ratio or degree.

CHAPTER IV.

ON MANURING CHEMICALLY CONSIDERED.

MANURING, chemically considered, deserves to be ranked as one of the most important sciences with which men have to deal. Greater issues are dependent on it than on almost any other science; and on the amount of knowledge of it possessed by the people of a country, and on the profitable application of that knowledge, the welfare, and perhaps the existence of a nation may depend. Hence, the researches of all scientific or other people who have devoted their attention principally to this branch of agriculture are in the highest degree valuable, not only to agriculturists themselves, but to the whole nation.

The principal names which will at once occur to those who have read to any extent the works of modern agricultural writers will be Messrs. Lawes and Gilbert, who have instituted over a long series of years a number of practical experiments on selected plots of land, giving results of great value; Baron Liebig, whose researches may perhaps be said to partake more of the laboratory than the field;

M. Voelcker, and Mons. Ville, in France. Each of these four have, as far as we can judge, been travelling on slightly different lines, and M. Ville may lay claim to having first hit on the expedient of trying his experiments on a soil which he had previously deprived of all natural fertility—that is, on sand which had been calcined or burnt. The advantage of this method was that he knew for certain that any effect produced on the plants experimented on was produced by the substances he put in, and not by anything that was in the soil to start with, whereas in all experiments conducted on plots of land with the soil in an ordinary state, a certain allowance had to be made for the effect produced on the plant by the soil; and this increased the difficulties of the experimentalist to a very great degree, by giving very variable, and sometimes even contradictory results, from the same substances.

I do not, in pointing this out, mean to assert that therefore M. Ville's discoveries are of more importance than those of others, but I should classify them as follows:—The reading of Liebig's discoveries tends to give anyone the chemical knowledge necessary to carry on experiments; M. Ville's researches teach him the result of those experiments; and the long-extended and various labours of Messrs. Lawes and Gilbert will teach him how best to apply the knowledge obtained from the other two to practical agriculture.

Just as it is necessary to combine various chemical substances in order to produce a fertile condition of the soil, so the writings of all three combine to furnish the agriculturist with the information necessary for a successful application of the knowledge when obtained.

The result of their combined researches, as far as can be ascertained with any certainty in a science which is still progressing, and is not yet, so to speak, fully developed, appears to point to this :—

1. That numerous elements, both organic and inorganic, enter into the composition of almost all plants cultivated in husbandry.

2. That out of this number some few elements stand out as pre-eminently necessary, or necessary in larger quantities than others.

3. That the number of these latter is not so great as was at first supposed.

4. That the plant derives most of the organic substances in the first instance from the atmosphere, and all the inorganic substances from the earth.

I should here point out that, by a happy confusion of nomenclature, the words 'organic' and 'inorganic' have got to be used in agricultural writings in a totally different sense to that in which they are used in ordinary chemistry, and that consequently the student is repeatedly perplexed. For instance, in ordinary chemistry, any substance that is supposed to be endowed with either animal or vegetable life, or to

have been once so endowed, is called organic; any substance that has not been so endowed, is called inorganic. All substances are described as divided into animal, vegetable, and mineral, of which the first two are called organic and the third inorganic.

In writings on agricultural chemistry, however, we find manures constantly described as 'mineral' and 'organic' manure. But when the reader comes to inquire into the meaning attached to the term, he will find manures described as mineral which he would call organic, and substances described as organic which have no right whatever to that name.

Thus, to give an example, let us take a leg of mutton bone. No one in ordinary parlance would, I think, term this a mineral, as it has recently formed an important part of an animal; yet if this leg of mutton bone were to be ground up into powder and then spread on the land, it would be described by a writer on agricultural chemistry as a 'mineral' manure.

Let us now take another well-known substance, saltpetre, or nitrate of potash. It would be difficult to persuade anyone that this substance when dug out of the ground partook either of an animal or a vegetable character; but we find it classified with other similar substances as nitrogenous organic manures.

I believe it was due to this confusion more than any great difference in the opinion entertained by the two parties that gave rise to a lively and rather

acrimonious controversy which appeared some years ago in the pages of the 'Royal Agricultural Journal,' between Messrs. Lawes and Gilbert on the one hand, and Baron Liebig on the other, relating to what was popularly called the mineral theory of the latter.

Be this as it may, I propose to discard in this chapter the terms mineral and organic, and to use other means of describing the different classes of substances.

Mons. Ville, then, by clearing the soil in which he tried his experiments of all fertilising properties to begin, was enabled to try the effect of various chemical substances on the plants he selected, both separately and mixed together; and the course of his experiments led him to the conclusion that the four classes of plants, graminaceous, leguminous, bulbous, and cereal, could be grown if supplied with four different substances, phosphorus, nitrogen, potash, and lime; that is to say, that these four substances mixed together were all that was practically required to raise a crop of all the four sorts of plants on land that was absolutely unfertile, that is, on land that would not grow anything at all.

He also found out that in the case of the different classes taken individually, he could suppress one or sometimes two of these ingredients and still raise a fair crop. Thus, in the case of roots he could take away the nitrogen and still obtain a crop; and he could take away the lime and reduce the quantity of

potash to an infinitesimal amount in three of the classes of plants without their suffering any great injury. The value of his discoveries consisted in the fact that the number of substances apparently required to feed or sustain the life of the plants was reduced to a few.

The result of his and Messrs. Lawes and Gilbert's, and all other experiments published, tend to show conclusively that all plants require to be fed *principally* on two substances, phosphorus and nitrogen, and that they also require a small quantity of potash, and for the present I will confine myself to these three.

It is found, then, that a good crop of turnips may be grown on almost any soil by supplying them with a liberal quantity of phosphatic manure.

That wheat can be grown on almost any kind of soil by supplying it with phosphatic, nitrogenous, and potash manure, and on what may be called fertile soils by the addition of nitrogenous manure alone.

That the leguminous plants, peas, vetches, red clover, &c., may be grown on almost any soil by the help of the three above-named manures, and on fertile soils by the help of the phosphatic and potash manures.

Now the first conclusion anyone would be apt to draw from this would be that turnips did not require nitrogen, and that wheat did not require phosphorus. Both these conclusions would, however, be erroneous. Wheat requires phosphorus, and turnips require nitrogen. All that the experiments prove is that they

do not require these substances under ordinary circumstances to be supplied to them in the shape of manure.

We, therefore, have to find out how they obtain these two substances respectively.

Take the turnip first. This is a plant bearing large spreading powerful leaves, but with small feeble roots not ramifying or extending any distance. It cannot, therefore, extract any great quantity of food from the ground, but can obtain a much greater proportion from the atmosphere. If, therefore, it is supplied with the food it requires from the ground, that is, with phosphorus, it will help itself to the food that can be obtained from the air, that is, nitrogen; and as the air, and, consequently, the nitrogen, is everywhere on the surface of all kinds of soil, the turnip is found to flourish almost anywhere if supplied with large quantities of phosphorus.

We will now take the wheat plant. This plant is found to flourish on fairly fertile soils if supplied with nitrates alone; on poor soils it will not grow when supplied with nitrates alone, but will grow when supplied with both phosphates and nitrates. The reason of this is that the wheat is a plant not having such broad and powerful leaves as the turnip, and, consequently, not able to draw such large supplies of nitrogen from the air, but having very active and wide-spreading roots, it is able to help itself to a

sufficient quantity of phosphorus from the soil, *if* the soil on which it is grown contains phosphorus. It is this *if* that is the important distinction lying at the bottom of all agriculture. If the soil be fertile, that is, richly supplied with phosphates, and the wheat is treated with nitrogen in the shape of manure, it can obtain the phosphorus it wants *easily* and readily, and can devote its attention to running to seed and bearing a good yield of corn.

If there is a small quantity only of phosphorus in the ground, then it has to work hard for its living, and has to expend its vitality and strength in keeping itself alive, and has so much less to expend in bearing fruit. If there is *no* phosphate it will not grow at all. This is the reason why turnips will grow anywhere if supplied with what may be called (though it is not quite a correct definition) their special food, while wheat will only grow on land suitable to it.

This is also the reason why turnips do not impoverish the soil, and why wheat does impoverish it.

If a crop of turnips are grown with phosphates and then drawn and removed from the ground, they take away with them the phosphates they have received as manure and the nitrogen they have extracted from the air, and leave the soil as they found it.

If they are consumed on the land by stock, or still more if they are chopped up and ploughed in, they return to the soil the phosphate that has been

supplied to them and the nitrogen they have supplied themselves with, and leave the soil in a fitter state than before to receive any crop which requires to be supplied with nitrogen.

In the one case they do the soil no harm, and in the other case they enrich it. In the case of the wheat plant, on the contrary, if a crop of wheat is grown on fertile land, with the assistance of an artificial supply of nitrogen, and it is then removed from the ground, it will take with it (1) the nitrogen that has been bought for it; and (2) the phosphates it has extracted for itself from the soil, leaving the soil as much the less fertile than it was before as is represented by the quantity of phosphate it has taken from it.

If the wheat is consumed on the ground, or even if it were ground up and ploughed in, it would restore to the soil only the nitrate that has been purchased in the shape of manure and phosphates that were there before. Thus it will be seen that while a crop of turnips grown with purchased phosphate will do no harm to the soil if the crop be removed, and will do the soil good if the crop be returned to it, a crop of wheat, on the contrary, grown with purchased nitrate, will do harm to the soil if removed from it, and will do no good to the soil even if returned to it.

The profit on growing a crop of wheat, then, will depend on what is left after deducting the cost of

growing it, plus the value of what it has taken from the soil. The profit on growing a crop of roots will depend on what is left after deducting the cost of growing them, *less* the value of what they return to the soil when consumed on the land.

These considerations will make it clear to the student of agriculture why roots are generally consumed on the ground and considered an improving crop, and why wheat is generally sold off the land and considered to be an impoverishing crop; also why land will grow roots that will not grow corn.

The advisability of putting phosphatic purchased manures into the ground when the turnip crop is sown is now pretty generally established, and forms part of every system of good husbandry. Land that will not grow a crop of either roots or corn worth speaking of in its natural state, can be made to produce a large crop of roots by the application of phosphates; and then if those roots are eaten on the land, the soil is found to have got a sufficient quantity of nitrogenous manure incorporated with it by means of the turnips to grow a good crop of barley. It is probable in this case that the turnips do not take up *all* the phosphate, and that the sheep which eat the turnips do not extract all the phosphate contained in the turnips, but return some of it, as well as a good deal of the nitrogen drawn by the turnips from the air, to the soil again.

It is, however, a question on which opinions are

still very much divided, whether a regular system of application of nitrates with the corn crops are beneficial, that is, are a source of profit.

It seems to be pretty well established, that the application of nitrate with the corn crops to a soil abundantly supplied either by nature or artificially with phosphates will increase the yield of corn sometimes to a considerable extent, but it must do this at the expense of the fertility of the soil, and so far to the detriment of the succeeding crops. There are two cases, however, in which this deterioration does not cause any very important injury either to the owner or occupier of the land. The first case is when the land is naturally deficient in phosphates, and the phosphates have to be supplied in the shape of manure. In this case it is a question of the balance of profit and loss. If the crop of corn will leave a profit after paying for the phosphates and paying for the nitrates, the land will be left pretty much as at first; and after the corn crop phosphates will have to be supplied to the root crops again as before. In this case, if the operation pays, the farmer can go on using phosphates and nitrates for a series of years, and by applying a dose of phosphates *without* nitrates at the last, he may leave the soil in as fair heart as ever it was, that is, as far as these two manures are concerned.

The other case in which I think nitrates might be used without ultimate loss, is in the case of strong clay lands which abound in phosphates, but in which

the phosphates are not easily extracted from the ground by the roots of the corn plants.

In this case, whether phosphates are applied in addition or not, it is certain that those contained in the soil naturally cannot become a source of profit to the cultivator *until* they are converted into plant food and taken up by the plant; and if the nitrate is a means of effecting this at a quicker rate, its use may be judicious, and certainly ought not to be prejudicial to the owner of the soil if he reaps the benefit of the increased crop himself. If, however, the land is let to some one else, it may easily prove a source of profit to the tenant who gets the harvest, and at the same time a source of loss to the owner of the land whose soil keeps deteriorating under the process. In this case, as far as the owner is concerned, it is all a question of rent, and if he can, by the use of nitrate being adopted by the tenant, obtain a higher rent for his clay land than he could if nitrates were not so used, he will be recouped by the increased rent and may be a gainer instead of a loser.

It will, however, appear pretty clear that it is not a judicious operation to purchase nitrates to apply to plants that can obtain the quantity they require without it being applied, as in root crops. That in the case of plants whose powers of obtaining phosphorus from the ground and nitrogen from the air are pretty equally balanced, in this case the application of nitrates ought to be accompanied with a

corresponding application of phosphates; and that in the case of plants such as the cereal or corn crops, whose power of assimilating phosphorus from the ground is in excess of their powers of inhaling nitrogen from the air, then the application of nitrogen may be in excess of the application of phosphates, if the soil be of a nature to contain phosphorus. This, I take it, is a fair statement of the theory of manuring, chemically considered, as far as relates to two principal ingredients contained in plant life.

As regards the third substance, designated by M. Ville as one of the elements of plant life, I do not think the results of the experiments hitherto tried are quite so conclusive as to the part it plays as plant food, as they are in the case of the first two named substances.

The experiments hitherto published appear to point to this distinction between them, namely, that although potash is necessary to the development of the plant, and although plants will not grow in soils destitute altogether of potash, even though there may be an abundant supply of other materials, there is still this difference between them, that whereas in the case of the first two, nitrogen and phosphorus, the more you put on the larger crop you get, this does not seem to be the case with potash, inasmuch as a small quantity seems to have the same effect as a larger quantity. And in cases where the soil contains potash, as in clay, the application of purchased potash does not

seem to produce any beneficial result. If you dress a field for roots with phosphate, and dress one part twice over, you will get the biggest crop where you have applied the manure in double quantity, and the same will be the case to a certain extent with corn crops on the application of nitrates; but if you dress a field over with potash, and then dress part of it over again a second time, I do not think it will be found that the second application will produce a corresponding result to what you will obtain in the other two cases.

It would appear to be more the rule in the case of this substance, that a certain quantity of it is required to be present in the soil, that quantity being very small, and that the application of a larger quantity is attended with no beneficial result.

With regard to the fourth substance, mentioned by M. Ville as one of the staple foods of plant life, I should doubt its being right to class it as plant food at all.

It is well known that some descriptions of lime appear to contain elements of fertility; but this may be easily due to their containing a small quantity of phosphates, and not to the lime as lime.

The proper function of lime is to decompose more quickly and more completely any vegetable mould in the soil, and to render it assimilable by the roots of the plants.

It also acts in the case of strong clay by a process

somewhat analogous to the action of fire, and renders the component part of the clay less tightly bound up together, so to speak, making it more easy for the roots of the plant to feed upon.

As regards the first case, that relating to vegetable mould, or *humus* as it is called after it has become decomposed to a certain extent, I cannot do better than quote M. Ville's own words:—

'It remains to explain the part played by lime. Here the question becomes more complicated. An experiment made with nitrogenous matter, phosphate of lime, and potash only (that is, in growing corn in calcined sand), gave a crop of 340 grains, while we obtain 370 grains with the complete manure, by which I understand the mixture of nitrogenous matter, phosphate of lime, potash, and lime. This slight difference seems to indicate that lime plays only a secondary part. Nevertheless, agricultural practice obtains very good results from it. We must, then, seek by other ways to discover what may be the nature of its action.

'If we substitute a mixture of sand and humus for pure sand, the yield remains like the preceding, equal to 340 grains. (By this M. Ville means that nitrogenous matter, phosphate, and potash, added to a mixture of sand and humus, but without any lime, gives 340 grains.) In the absence of lime, the humus has then no action either useful or injurious. But if we add lime in this same experiment, the yield imme-

diately rises to 493 grains; the lime, which in the absence of all organic matter influences the yield in but an insignificant manner, manifests on the contrary a very decisive action in the presence of humus, which produces no effect of itself when alone.' Thus far M. Ville; but he is, I think, quite wrong in the conclusion he draws, as he sums up in the next paragraph:—

'All the experiments point to this final conclusion, that the soil to produce plants' (he should have said cereal plants) 'must contain under an assimilable form a nitrogenous matter, phosphate of lime, potash, and lime, and that to insure the efficacy of this latter, the presence of humus is indispensable.'

I cannot help thinking that in this last paragraph M. Ville has got rather mixed up in his conclusions, and that instead of saying that the presence of humus was required to insure the efficacy of the lime (that is, I presume, as plant food), it would have been more correct to have said that to insure the efficacy of the humus, the presence of lime was indispensable.

Supposing you were trying to describe the conditions necessary to insure a man a good dinner, and you stated the case thus:—In order to provide a man with a complete dinner, the room must contain in an assimilable form, bread, vegetables, and a leg of mutton; but in order to insure the efficacy of the latter, its previous application to a kitchen fire is indispensable. This would be correct, but if, instead of this, you were to put the matter as follows:—

In order to provide a man with a complete dinner, the room must contain bread, vegetables, and a kitchen fire, and that to insure the efficacy of the latter, the presence of a leg of mutton is indispensable, this would hardly give a correct idea of what the man would get his dinner off, and would lead anyone to suppose that after the leg of mutton had been roasted by the action of the heat, the man would eat the kitchen fire.

Humus, being decayed vegetable matter, contains all the nitrogen that was in the plants composing the humus, and the presence of lime is requisite to enable the succeeding crop to take up the nitrogen.

I think we may account for the small difference between 340 and 370 grains in the crop obtained by adding lime to calcined sand without humus, to the presence of some other substance in the lime rather than to the presence of pure lime. It is well known that the manuring power of different samples of lime varies; thus, lime from Knottingley is found to be better for agricultural purposes, and worse for building purposes, than lime taken from other parts of the country.

CHAPTER V.

ON ROTATION OF CROPS.

FEW people who take sufficient interest in agriculture to read this book will require to be told that in this country no farmer is in the habit of taking the same kind of crop year after year in succession from the same field. It has often been done by way of experiment on small plots of land, chiefly with a view of testing the efficacy of different kinds of manures, but never in agricultural practice, with one exception, and that is in land laid down to permanent pasture or meadow, which remains down, yielding the same crop year after year without deteriorating in the case of pasture, and without deteriorating, if manured, in the case of meadow.

In the case, however, of all lands where the soil is broken up by the plough, and each crop is sown by the husbandman, it has long been the universal custom to have each crop followed, as well as preceded, by a different crop, and to alternate cereal crops with either root crops or leguminous crops; and it is found in practice to be most convenient and most beneficial to alternate the cereal crops with the other two, and

to grow the other two alternately, that is, to grow first a root crop, then a corn crop, then a leguminous crop, then a corn crop again, and this is the explanation of the four-course system. When I say it is most convenient and most beneficial, I must remind my readers that there are two other considerations besides profit which the farmer has to take into account, and which play an important part in modifying all his operations. The first consideration is the manuring or fertilising of the soil, and the second is the *manipulation* or application of labour to it. As regards the second part, it is obvious that if a farmer had to plough, harrow, clean, and sow all his land every year, he would require twice as many cart-horses as he would if he confined those operations to half of the land; and that if he sowed all his land with corn and roots one year, and had it all in clover the next year, he would require a large force of horses the first year and none at all the second. It will be seen from this, that the mechanical details of working the land oblige him to alternate crops requiring a large quantity of labour to be bestowed on them, with crops requiring little or no labour to be bestowed on them, and this factor in the determination of the rotation of crops applies with equal force on all descriptions of soil.

As regards the first condition I have mentioned, namely, the manuring or fertilising of the land, or rather, I should say, the maintenance of the land in

such a state of fertility as will enable the farmer to grow profitable crops, it will be found that the nature of the soil itself is an important element to be taken into account, and that while the amount of labour required to be employed is a consideration which applies with equal force in the case of all sorts of soil, the consideration of maintaining the fertility of the soil varies inversely with the natural fertility, and weighs most heavily on those lands which are least fertile, such as barren land, while it sits most lightly on the most fertile descriptions of soil, such as warp land, or the richest belts of clay loam.

Roughly speaking, it would be tolerably correct to say that the green crops, that is, the root and leguminous crops, are alternated with the cereal crops for the purposes of obtaining manure to maintain the fertility of the soil; and that root crops are alternated with leguminous crops in order to economise labour.

Or, to put it shortly, that root crops are grown with a view to increasing the income of the farm, and leguminous crops are grown with a view to reducing the expenditure.

The advantage of the four-course system is shown the most on lighter soils. It was originally introduced by the Earl of Leicester, at Holkham, in Norfolk, and was attended by such beneficial results that it has gradually spread all over the country, and is now, as a rule, made one of the conditions of the tenure of land. By adopting this system of cultivation, land

that formerly was occupied as a sheep run, letting for about 2*s*. 6*d*. per acre, is now enabled not only to rear and feed three or four times the quantity of stock it would carry before, but also to grow a very fair quantity of cereal or corn crops besides.

The only description of land on which the four-course system has not given such satisfactory results is in the case of the stronger clays. There are two reasons for this. In the first place, owing to the nature of the soil, it is found that although root crops can be *grown* without difficulty, they cannot be eaten on the land, and have therefore to be carted away; therefore one great inducement to grow them is absent, as growing roots and then removing them does not in any degree enhance the fertility of the soil in which they are grown.

The other reason is, that the clay lands contain in themselves a sufficient amount of fertility for the growth of cereals, but a genial season is required to promote their development. In the case of sand, you can grow a crop of corn in almost any season, and with any kind of weather, if the elements of fertility have been supplied to the soil by means of the preceding crop.

In the case of strong clays, however, the weather has more to do with the yield of the corn crop, and is of more consequence to it than the course of cultivation previously adopted.

Good clay will, of course, produce better crops

of wheat than poor clay, and well-manured clay will produce more corn than the same clay will without manure if other things are equal; but a slightly manured field of clay will sometimes produce more corn in a good season as regards weather than a highly manured field will in a bad season; and it is quite possible to grow two crops of corn running in the same clay field, without any application of manure between, and for the second crop to be better than the first.

It will be seen from this that whatever course of cropping be adopted in clay land, the uncertainty attending the result will be greater than on sand, and it is this uncertainty which constitutes the chief difficulty in turning arable clay land to a profitable account.

If a farmer had one clay field, and were to grow green crops and corn crops on it alternately for a series of years, it might happen that the season was always favourable for corn when his land was in green crops, and always unfavourable when the land was in corn; and it is easy to see that under these circumstances he would derive little or no profit from his farming, while if the conditions were reversed, his profits might be very large. If a man's whole farm were clay, this vicissitude of the seasons would not affect him materially, as, if he grew green crops and corn crops on each field alternately, he would always have half his land growing corn, and could not miss getting the benefit of the favourable seasons.

The lesson we ought to draw from this is that, while green crops may safely be alternated with corn crops on all soils, if the whole farm be of the same description of soil, still, when the farm is a varied one, comprising both clay and sand, in that case it is not advisable to include the clay in the same course as the sand; that is, if a man has both sand and clay, he ought to arrange his land so that he will have a complete four-course system on the sand without including the clay, and he ought to farm the clay fields on the system he finds most beneficial for clay, without any reference to his sand land. That is, a man who has a farm containing both sand and clay land should go on as if he had two distinct farms.

Nothing can be a greater evidence of the uncertainty attending the cultivation of clay land, and the difficulty of fixing upon any particular system of successive cropping, than the fact that after considerably upwards of two thousand years' experience no definite system has been hit upon sufficiently good to have been universally or even generally adopted. And we find even at the present day a dozen different ways of treating it advocated by as many different authorities.

We find, on referring to the Roman writers on agriculture, that the course adopted in that country in the time of the commencement of the Roman Empire was to have half the land in grain and half in fallow every year; and one-third of the fallow half was sown with

some sort of green crop to be consumed on the farm. And this was the only part manured, the other two-thirds being left in what we should call a summer fallow. By this method one-sixth of the land was manured every year and grew green or fallow crops, two-sixths was summer fallow, and three-sixths, that is half the land, was bearing grain.

We must remember that the conditions under which agriculture was carried on in the time of the Romans varied in two important particulars from those applying to modern farming in this country.

In the first place the Romans were, as far as we know, utterly unacquainted with the use of what are called artificial manures; and, secondly, their climate was totally different to that of England, and they suffered from little or no inconvenience on that score.

Taking these two things into account it is difficult to improve on their practice. Laying aside, however, the Roman practice and returning to more modern times, I will briefly explain the nature and object of what is popularly called a summer fallow, but which really should be described as a twelvemonths' fallow, the land being left for a whole year without growing any crop, and being in that interval ploughed a certain number of times, to prepare it for the crop which is to be sown the succeeding year, which crop is almost invariably wheat.

The object of this kind of fallow then is threefold. First, to pulverise as great a quantity of the soil by

exposing it to the air as possible. Second, to give all the seeds of annual weeds an opportunity to germinate, so that they can be destroyed by a subsequent ploughing. Third, that by exposing the surface of soil once or twice to the action of the hot summer sun, the clay may get baked so hard that the twitch or couch grass will be destroyed.

There is a fourth advantage to be gained by a fallow in the opinion of most scientific agriculturists, and that is that the clay soil is believed to have the power of absorbing nitrogen, or ammonia, which is one form of nitrogen, from the atmosphere, and that by constantly exposing fresh surfaces to the air by ploughing, the soil lays in a stock of nitrogen sufficient for the requirements of the wheat crop that is coming. Be this as it may, it is found in practice that a clay field which will not grow a satisfactory crop of corn without being fallowed, will, after the sort of summer fallow I have described, be found to be sufficiently fertile to do so.

It will be seen that as far as the last-named benefit is concerned, it is immaterial what state the land is in when ploughed, or what time of the year the ploughing takes place.

With regard to the third, two things are indispensable, a dry condition of the soil and a hot sun. With regard to the second the weather is not so material, but the time of year is confined to spring and early summer. While with regard to the first it will easily

be understood that while the season of the year is immaterial, dry weather is, on the other hand, indispensable.

It follows from this that while a winter fallow is always beneficial, a summer fallow is only necessary when the land is foul with annual weeds or twitch. As a rule, the land is dry just after harvest, and generally in spring about the time that spring corn is sown; and when this is the case, the two objects of pulverising the soil, and exposing it to the atmosphere, may be accomplished between the harvesting of a crop of wheat and the sowing of a crop of barley or oats. It is possible that if the practice were tried of growing a crop of wheat and a crop of spring corn alternately, and of consuming the alternate crops, that is, every other crop, on the farm, and returning the manure to the land, it might be found to answer.

CHAPTER VI.

ON MANURING PRACTICALLY CONSIDERED.

I HAVE in a former chapter treated at some length on the question of manuring as to its chemical effect on the soil and the crops. It happens, however, that many other considerations are involved when you come to the question of applying manure to the large area comprised in an ordinary farm. The principal of these considerations are:—1. The practicability of carrying out the application of the manure. 2. The convenience of applying it at one time more than another, or to one crop more than another. 3. The relative expense of the cost of the manure, and the return it is likely to make. 4. The time which is likely to elapse before the return made by the application of the manure assumes a money value.

All these considerations induce or rather compel a farmer to often deviate in practice from what he knows theoretically would be best to be done were there no difficulty in the way of doing it. I will take each of the considerations separately as I have enumerated them.

First, then, as to the practicability of applying

the manure. It often happens in the case of strong clay land that it is impossible to get on the land with heavy-laden carts without doing more damage to the land than the manure will do it good, and in this case the farmer is obliged to abstain altogether from leading the farmyard manure, although he is perfectly aware it would have a highly beneficial effect if it could be applied without injury.

Secondly, as to the convenience attending the carrying out and application of the manure. In this case it often happens that, although the farmer may be in possession of the manure, and although it would be beneficial to apply it to a certain crop, he is prevented from doing so by the fact that he is unable to spare the horses to do the carting necessary, that is, that he is too busily engaged in doing something that is more important and more beneficial still; as, for instance, in hay or harvest time, when he would be sure to lose more money by neglecting other work than he would gain by applying the manure at that particular time. This consideration, therefore, leads the farmer to select the time when he is least busy to apply the bulky farmyard manure to the land, and this without any reference to that being the best time, chemically speaking, of doing so.

The third consideration is the relative expense of the application of the manure and its probable return. In this case the farmer knows the cost of putting the manure on, but he can only estimate

the increased produce he is likely to get and the price that increased produce will sell for. It may often happen that a quantity of a certain manure may give a liberal increase in the crop, but from the high price of the manure and the low price of the crop produced by it the transaction may be a losing one instead of a paying one. This uncertainty is often sufficient to deter a farmer from using and applying fertilisers on a large scale, which are proved to be highly beneficial when applied by way of experiment to small plots of land.

The fourth condition, the time which is likely to elapse before the outlay produces a money return, affects the farmer more or less in proportion to whether he has the money to lay out in the first instance. If a man could buy artificial manure, and be certain of realising the value of the crop produced by the manure in a very short time, he would be more likely to use it than if he had to pay for it a considerable time before he reaped the benefit from it.

It will be seen that the first two considerations apply chiefly to the bulky manure usually produced on the farm, and the last two to purchased, or what are generally called artificial, manures; and that the first two are governed, in a great measure, by the kind of farm a man has, and the last two by the amount of capital he possesses. A man can always apply the artificial manure he wants, but he cannot always pay for it; he can always obtain the manure

he makes on the farm, but he cannot always apply it.

The result of all these different forces, so to speak, acting on the application of the manure commonly used on a farm, has been to reduce the application of manure to a system something in the same way that the rotation of crops is reduced to a system, that is, a man finds it always convenient to apply his farm-yard manure at a particular time of the year because he is always least engaged with his horses at that time. He finds it always worth his while to buy artificial manures to apply to certain crops when it is not worth his while to buy them for the sake of applying them to others; and this is always the case, and does not vary from one year to another. This system, being founded partly on the exigencies of labour, is not always that which is the most beneficial that could be imagined, but it is probably as beneficial as any that could be practically carried out.

The method, then, which was formerly found to prevail generally in many places where the four-course system was carried on was to cart out the manure made in the fold-yards at intervals during the winter, and to make a hill of it, and in spring, when the land intended for roots had been sufficiently cleaned to apply the manure in ridges made for the purpose, for that crop. This was before the use of phosphates had become so general and so well understood as it now is. It was found in course of time

that a good crop of roots could be grown with tolerable certainty by buying a certain quantity of phosphatic artificial manure, and applying it in the same manner as the farmyard manure and instead of the farmyard manure.

There were two advantages and one disadvantage in adopting this change. The advantages were, first, that the labour of carting the farmyard manure to the land at a busy time of the year was saved, and, secondly, that the farmyard manure was set at liberty to enrich some other crop. The disadvantage was that the phosphatic manure had to be paid for instead of being produced on the farm. It was found, however, that the advantages preponderated. The change enabled the farmer to grow a larger breadth of roots than he otherwise could, and the operation proved a profitable transaction when the balance of profit and loss was struck.

The tendency of this change, however, was to increase the amount of roots grown, and therefore the amount of stock kept, and therefore the amount of manure made, and therefore the amount of corn grown on any given number of acres, while at the same time it increased the outlay *per acre* by the amount spent in artificial manure. The tendency, therefore, of this change was that a man found he could produce more corn from a given number of acres than he could before, but that he required more capital *per acre* to do it. Having thus, so to speak, got his farmyard manure on

his hands, the farmer cast about for the next best thing to do with it, and naturally turned his attention to manuring the most valuable crop—the wheat crop. He also found that there was an interval between gathering in one wheat crop and sowing the next, when he had leisure to cart the manure either from the farmyard or from the hill and spread it on the land, and this plan gradually came to be adopted. There were three objections to this plan. One, that the manure lay idle for six months, and produced no return in money for eighteen months. Secondly, that the manure wasted, and some of its valuable material was washed away or evaporated. The third objection was, that although the farmyard manure contained the necessary food for the wheat plant, it did not contain it in a sufficiently assimilable form, and that it was only partially taken up.

It was found that farmyard manure freshly applied was too raw, so to speak, for the roots of the wheat plant to take up, and that it consumed better in proportion to the length of time it had been in the ground before the wheat was sown. So much was this the case, that where the land was heavily manured, instances were found where, if two wheat crops were grown in succession, without any manure being applied between, the second crop gave a better yield than the first, which tended to show that a smaller quantity of manure in a more advanced stage of decomposition would produce a better corn crop than the larger dose

of fresh manure. This fact, and the loss of time, and the waste of the elements of fertility, combined to induce the farmer to apply the farmyard manure to the crop immediately preceding the wheat crop, which in the four-course system consists of clover or some other of the leguminous plants. It was found that the leguminous plants would absorb any quantity of manure and flourish on it, no matter what state it was in. In the case of its being applied to clover, the clover was either mown or grazed; if grazed, the fertilising ingredients were returned with interest all through the summer, and were left in a more assimilable form ready for the wheat. If the clover were mown, it was found that the consequent luxuriant growth of stalk and leaf above ground had induced a corresponding increase of root below ground, and that when the crop of clover hay was removed, there was a sufficient quantity of nitrogen remaining in the roots to furnish the wheat with what it required.

It will be observed that I have not mentioned the part played by the application of artificial manures containing nitrogen or ammonia, such as nitrate of soda. The use of these salts, although they have been known for many years, has not yet been sufficiently recognised as a benefit for them to have acquired a place as yet in any recognised system.

I will, however, point out a few things which will enable my reader to partially estimate their value, and give them a place in his estimation of the various

fertilising agents. In the first place he will find the most contradictory opinions entertained by people who have used it. One man will say that it exhausts the land much more than it increases the crop; another will say it has no effect at all, and is a take in; another will say it will give good results, and does not injure the subsequent crop; and they all point to experiments they have tried, as conclusive proof of the truth of their assertions. The fact is, that the use of nitrate of soda presents all these aspects according to the time, place, and manner in which it is used.

Where it has done injury, it has been used to the right crop at the wrong time; where it has had no effect at all, it has been used to the wrong kind of crop; and where it has been successful, it has been used to the right crop, and has been followed by such a treatment of the land as science has found to be required after its use.

We will first consider the case in which it has been found to do harm. In this case it must have been applied to a crop on which it takes effect, and must have caused that crop to have an injurious effect on the land as regards growing the subsequent crop. If the nitrate were applied to a crop on which it had no effect, it is difficult to see how it could have an injurious effect on the soil, inasmuch as it would have taken nothing from it, while it would have added to it some of the elements of fertility. It may therefore

be said, as I stated above, that the application of nitrate of soda does harm when applied to the right crop but at the wrong time, and I might add under wrong conditions. Let us suppose, for instance, that a liberal dressing of nitrate of soda is supplied to a crop of corn sown down with a crop of clover, to be followed, after the clover is ploughed up, by another crop of corn, say wheat. In this case the application of the nitrate to the first crop of wheat will stimulate the growth of the wheat plant considerably, and as the wheat plant requires phosphates in addition, the extra growth will cause the plant to extract a much larger proportion of phosphorus from the soil, leaving so much the less phosphorus for the succeeding crop, which in this case is clover. It will easily be seen that in this case, if the price of nitrate is high and the price of wheat be low, it may happen that the increased yield of wheat will only just about pay for the cost of the nitrate, in which case all that the farmer will have done will have been to extract a certain quantity of phosphorus from the ground and parted with it without getting anything for it. The clover, finding a diminished supply of phosphorus in the soil, will take some of what is left, but will not flourish as well as if there were more, and will not consequently inhale so much nitrogen from the atmosphere; that is, it will take more of the food away from the succeeding wheat crop from the ground, while it will supply less of it from the air. If a second wheat crop be now

grown without further manuring, this second crop will fall below the mark quite as much, or more, than the other rose above, and the result of the whole will stand as follows to the farmer :—

1. Crop of wheat improved, but only just paid the cost of improving it, no advantage.

2. Crop of clover not so good as it ought to be, loss to that amount.

3. Crop of wheat much worse than it ought to be, more loss than on the last.

Total :—Injury to two crops, and no beneficial result to the farmer from the third.

This man would not be inclined to try the application of nitrates again in a hurry, and would probably reply, if anyone tried to convince him that nitrate of soda was a fertilising agent, 'It's all very well theoretically, but I've *proved the contrary*, and I won't have anything to do with it.'

We will now proceed to the second result of the experiments mentioned, that is, when the application of the nitrate has no effect whatever. We will suppose a dressing of nitrate applied to some old pasture or meadow land in a park; the result would probably be a slight spurt on the part of the grass for a short time, but little or no difference in appearance in the course of a month or two. This experiment would most likely have been tried by the owner of the land, as a tenant rarely applies anything to his pasture land, for fear his landlord should derive some

benefit from it, and in this case the verdict would probably be, 'A mere flash in the pan, sir; one of those catchpenny things.' The reason of the application of nitrate failing to produce any beneficial result in this instance is as follows:—Land that has been grazed for many years is always tolerably full of nitrogenous manure to begin with, and grass can also extract nitrogen from the air as fast as it can extract phosphorus from the soil, and therefore the application of more nitrate only causes it to grow a little quicker for a short time, after which the other grass catches it up, the fact being that there is already as much nitrogen about as the plant requires. The same will apply to the treatment of the turnip crop, in which nitrate produces, if anything, an injurious result, the plant growing fine leaves instead of a large bulb.

Now, in the first of the three instances I have mentioned, the farmer would have known what the result would be before he began, and would have taken good care not to try such an experiment at all if he had been acquainted with agricultural chemistry.

We will now come to the third, or that case in which the application of a nitrate is found to increase the yield of corn to a beneficial extent. We will suppose a scientific professor, who knows already pretty well all that *is* known about the theory of chemistry as applied to agriculture, and who wishes to put his knowledge to a practical test.

In this case the experimenter knows what he is doing, and sets about his operations in a workmanlike manner. He begins by selecting a suitable piece of ground, and as a preliminary canter, he grows two crops of wheat running on it without any manure. This, he considers, will have the effect of pretty well cleaning up any stray nitrogen there may have been in the soil to start with. Having done this, he marks out a plot, and as his object is to ascertain how much effect on the crop a dose of nitrogen will produce, he puts into the soil, to begin with, a sufficient supply of the other two chief elements, as he considers them, of plant food, namely, phosphorus and potash. By doing this, he knows that the crop of wheat, if it fails, will not fail for want of those substances in the soil. He then sows the plot with wheat, and applies a dressing of nitrate at the same time, feeling tolerably confident that he will get a fairish crop of wheat. But, argues the professor, when the crop comes, how am I to prove that it is not due entirely to the phosphorus and potash? In order to prove this, I must apply the phosphorus and potash to a second plot, and sow that plot with wheat as well, then the difference between the yield of the two crops *must* be caused by the nitrogen applied, as the soil is the same, the atmosphere is the same, and the manure applied (with the exception of the nitrate) is the same in both plots. This is accordingly done, but yet another consideration occurs to the professor:—Supposing I

should happen to get a fair crop of wheat on both plots!

People may say that the soil possesses sufficient natural fertility to grow a crop of wheat without any manure at all. Where would be the value of my experiment then? It will be necessary for me to sow a third plot without applying any manure at all, just to let the people see the difference. This is accordingly done, and the professor awaits the result of the experiment. When harvest comes, and he reaps and thrashes his corn, he gets at the rate of from thirty-five to forty bushels of wheat per acre from the plot manured with both dressings, and about at the rate of sixteen bushels per acre from each of the other plots. This is about what he expected as between the plot saturated with nitrate, phosphorus, and potash and the unmanured plot, but he is rather puzzled to find that the phosphate and potash by themselves have produced, so to speak, no effect at all. After sitting down to reason this out, he comes to the conclusion that there is as much phosphorus and potash in the soil on which he tries the experiment as will balance the atmosphere; that is, the wheat can draw phosphorus and potash from this kind of soil as fast as it can draw nitrogen from the air, and that on this particular soil it is of no use to increase the quantity of phosphorus and potash contained in it, without at the same time affording the wheat an opportunity of getting at more nitrogen than

it can obtain from the atmosphere, by giving a supply of nitrogen to the soil as well.

The professor tries this experiment a second and a third year, and obtains the same results, the yield of each plot bearing about the same relative proportion to each other, but varying according to the season. By this experiment he considers he has established the fact that a good crop of wheat can be grown on land abounding in potash and phosphorus by simply supplying a substance containing nitrogen.

But the professor is well aware this necessary supply of nitrogen can be obtained from the atmosphere without buying it, by alternating with the wheat crop a turnip crop or a clover crop, and consuming them on the land. The question, therefore, that he wishes to solve is, whether, by purchasing and applying salts containing nitrogen, he can do away with the necessity of the alternate green crop and continue to grow the more profitable cereal crop. He continues, therefore, for another year or two to grow wheat on the same plot with the mixed manure, and obtains each year a crop without any apparent diminution. This would be sufficient to satisfy most experimenters, but the professor is a pertinacious man, and resolves in his own mind that he will, so to speak, *see that plot out.*

He finds it laid down by all agricultural writers that any land on which the same crop, either of roots, clover, or corn, is grown too often in succession,

becomes what is called sick of that crop, and refuses to grow it any longer. He therefore determines to go on growing wheat on the same plot, supplying each crop with its requisite food, and to find out how many seasons will elapse before the wheat sickness appears, entertaining no doubt that he will soon arrive at the termination of his labours.

But the professor has entered on a longer job than he had any idea of.

Years roll by, dynasties change, empires rise and pass away; the wheat crop which first travelled by waggon now goes by train. The face of the country is changed by a network of railways; steam thrashing machines supersede the old horse power; steam mills grind the corn into flour where windmills used to perform that operation; and still the unwearied little plot goes on, year after year, receiving its accustomed supply of manure, and yielding in return its accustomed quantity of grain. The professor, who is a young man when he begins, becomes first a middle-aged and then an elderly man, and finds himself apparently no nearer the end of experiment than he was at first; and after growing corn for as many years in succession as he gets bushels to the acre, he arrives at the conviction that there is no known limit to the duration of the wheat-growing powers of the soil when supplied with the requisite elements of fertility from without, and that to all appearance the plot of land he has been cultivating will go on producing wheat year after year

under the same treatment long after the professor has passed away.

Many of my readers may think that this is an imaginary description, and that I have drawn largely on my fancy in describing the experiment, but this is not the case. The portrait of the professor may, like Titian's Venus, be drawn partly from one experimenter and partly from another; but the result has been put on record as I have described it. Most people interested in agriculture have read some of the experiments instituted by Messrs. Lawes and Gilbert at Rothamstead, and if they look into them they will find that several years ago there was a plot of ground there which had been growing good crops of wheat for six-and-thirty years in succession, when supplied annually with purchased manures, pretty similar to those I have narrated.

CHAPTER VII.

ON THE INDIVIDUALITY OF VEGETABLES.

I HAVE pointed out, in another chapter, the nature of the substances on which plants feed, and the result of the numerous experiments instituted as to the sort of food different plants require, and the practicability of supplying them with that food.

It will be found, however, in addition to the variety of the substances on which different plants feed, there are other distinctions besides in the habits and customs of plants, in their ways of acquiring their food, in the conditions under which they flourish and the reverse, showing a strong individuality in the different groups of plants as they are ordinarily classified, and that there are the same points of distinction to some extent common to them as to the different classes into which any society of human beings is divided when developed by civilisation and culture.

Let us take the plants met with in the ordinary four-course system, representing four great classes of plants—the bulbous or root class; the leguminous, or properly vegetable class; the cereal, or corn-bearing class; and the graminaceous weed

class—and we shall find that there is a certain amount of analogy between these four divisions of plants, three of them modified by culture and the fourth wholly in a wild state, and four classes into which the ordinary population of a country are divided.

We will start with a field as it often presents itself at the beginning of a four years' course; at this time there is nothing in the field that has been planted there by the husbandman.

Now at this time we usually find the land more or less overrun by a wild creeping sort of grass, variously called couch grass, twitch grass, or wicks; this plant flourishing most in the most neglected places, eating up everything that comes in its way without producing any beneficial result, with a great tendency to overrun the surface of the land if not destroyed or kept in check by cultivation, always cropping up again where the vigilance of the husbandman is for a short time relaxed, restless and shifting its ground rapidly by extending its roots in all directions.

This plant may be said to bear a striking resemblance in its habits, uselessness, and the treatment it usually receives, to the lowest or criminal classes.

We will now take the next class of plants in the order in which they would come, namely, the root class, and consider their ways as compared with those of a corresponding class of human beings.

Here we have a totally different sort of nature, nearly the reverse of the first mentioned.

Unable to wander far in search of food, remaining always nearly where they are first sown; difficult to transplant; requiring to be carefully kept from the neighbourhood of the criminal class of plants above mentioned, with great powers of reproduction; able, if supplied with the necessaries of life in the shape of phosphorus, to obtain all the rest they require for themselves, but requiring to have the necessaries of life supplied to them in a form easy of access; enriching the soil they occupy for the benefit of the next succeeding class; becoming fine specimens of this class if liberally treated with the food required by them, but running to seed and flower if supplied too freely with luxuries in the shape of substances containing large quantities of nitrogen, the turnip bears a striking analogy to the agricultural or labouring class, and, like them, are the first class who ought to and generally do colonise or occupy and bring into a more useful condition districts which wild beasts or savages have lately had the sole run of, and from which, by advancing civilisation, they have been driven.

We now come to the third great division in the order of cultivated plants, that is, the leguminous, or properly vegetable, of which I will take peas and vetches as a fair sample.

Here we have a change as great as that between the turnip and the couch grass.

We now find ourselves in company with a class of plants not able, like the turnip, to exist with only the bare necessaries of life put within its reach, but requiring, at any rate to start with, a locality moderately supplied with both the comforts and the necessaries of life; but, on the other hand, when these are supplied, able to a much greater degree than the last class to protect themselves against the inroads of the criminal classes, with greater powers of spreading and filling up the land, flourishing to a luxuriant degree where the soil is rich and fertile, but unable to occupy any country for long together exclusively, that is, without being brought into contact in turn with both the other classes of cultivated plants. The leguminous plants are the trading or middle class of the system of cultivated vegetable life.

We now come to the fourth or highest class in the scale of plant life, that is, the cereal or corn-bearing crops, which may not inaptly be likened to the territorial or landed aristocracy of a community.

Like them, their roots take deep hold in the soil; like them, the highest and most valuable specimens are to be found in their ranks; like them, they can withstand, in a far greater degree than the class immediately below them, the chilling frosts of adversity and the devastating effects of the tempest; and, like them, they languish and do not arrive at perfection without the fostering care of the comforts and luxuries of life; but, like them, if supplied with

these in moderate quantities, they will provide themselves, from the soil to which they belong, with the necessaries of life, which have, in the case of the working classes to a great extent, and in the case of the trading classes to a certain extent, to be put within their reach.

CHAPTER VIII.

ON LAYING LAND DOWN TO GRASS.

THERE is an old adage which runs as follows:—

> To make a pasture will break a man,
> To break a pasture will make a man.

The first part of the adage may have some truth in it still, but the glory of the second is departed. Fortunes are not now to be gained by ploughing up good grass land and growing wheat, heavily taxed in the shape of rates, and obliged to compete with wheat from other countries poured into our markets free from all toll, and fetching less than two pounds a quarter. Whether the first part of the adage be still true or not, the practice of laying land down to grass is becoming daily of more frequent occurrence. The growth of corn is attended with continuous and heavy expenditure of labour, and, at a certain price, yields absolutely no profit whatever; and the nearer this limit is reached, the less corn will be grown, and the only alternative is to devote the land to raising and feeding stock, that is, to convert it into pasturage in some shape or other.

Many are the prescriptions that have been published for effecting this laudable object, several of them being, indeed, ready means for bringing about the prophesied result.

Anyone wishing to convert some land that had hitherto been under the plough into permanent grass, should ask himself what his object in doing so is, and in what manner he can effect that object at the smallest outlay and in the shortest time. Instead of confining himself as many do to reading the circulars issued by seedsmen, and the directions contained therein, let him in addition study what nature says on the subject by going and inspecting the grass on the road side, and ascertaining what it is composed of, and then considering how it came there, and whether similar grass is sufficiently good for him. If he is contented to convert his plough land into grass of this sort, there is hope for him in spite of the adage; but if he wants anything better, or anything which he thinks is better, his work is cut out for him for several years to come. He will find, then, that the grass on the road side bears a great resemblance to any old pasture in its vicinity, and he may reasonably take it for granted that it is composed of the plants most suited to the soil in that locality *in the condition in which it is*. If the condition of the soil be altered by artificial means, the nature of the herbage will be altered as well, whether he sows fresh seeds or not.

Taking then the roadside grass as his basis, he will do well to sow down the seeds of similar grass to begin with, as far as he can, and as far as these grasses suit his purpose, and not try to produce better herbage by sowing a better class of seed, unless he has previously altered the staple of the soil for the better by manuring it.

It will be of advantage, in pursuing researches on this head, to look about and see what has happened on land when unassisted by the operations of the husbandman.

Geologists tell us that a great part of the crust of the earth originally consisted of igneous rocks unfit for any ordinary vegetation. After a lapse of time, by the action of frost, rain, and wind, a slight powder was produced, and on this powder a low vegetation in the shape of lichen, a kind of moss, was able to exist. As successive crops of lichen grew and decayed, the store of soil became larger, and larger kinds of mosses flourished.

When a sufficient quantity had accumulated, small shrubs, then larger shrubs, then pine trees, were able to grow. These, in their turn, shed their leaves, decayed, and formed food for other plants, until a soil fit for cultivation by man, and suitable for the growth of the plants he required, covered the greater part of the face of the earth.

Let us now imagine, if we can, that a race of

intelligent apes had made their appearance on the scene at the stage when the surface of the rock was just sufficiently pulverised to grow the moss or lichen. And let us further suppose that, not considering the lichen to be a satisfactory kind of vegetable, they and their descendants had carefully scraped it from off the surface of the rock and burnt it for generations. Is it too much to assume that, in this case, the rock would produce nothing better than lichen to this day? And is not this what people are constantly doing to the soil in the present day?

I have constantly read directions given for laying land down to grass, which commence by saying that it is necessary to first thoroughly clean the land, in other words, to extract from it all vegetation that grows spontaneously; in still other words, to deprive the seed you are going to sow of all fertility derived from the growth and decay of previous vegetable substances.

Having carefully done this, the writers proceed to recommend that none but the finest sorts of grasses should be sown, that is, none but the sort that is least likely to grow; and after these have been coaxed by artificial and stimulating applications into a sort of existence, they find that the grass unaccountably dies away and remains unproductive for ten or twelve years, when a vegetation slowly returns, not of the grasses they have sown, which are long ago numbered with the slain, but of such original and indigenous herbage as escaped the massacre of all the natural

grass which took place as a preliminary to sowing the seeds.

Would it not be better to take example by the operations which take place when the ground is not meddled with by man, and to start with the crop which grows most freely on the soil, and by constantly feeding stock on it, on the land, and gradually introducing the seeds of a better class of herbage as the soil becomes adapted for it, to keep improving the pasturage which originally existed and is suitable for the soil, up to the pitch desired?

Let us start with a field from which the wheat crop has just been removed, and which, if continued as arable land, would be cleaned for a root crop. Supposing, instead of keeping it under the plough, the owner wishes to convert it into pasture land, and having a large extent of such land cannot afford to lay out the same amount on it per acre as he could on a small area.

He will find the soil probably full of annual weeds and the roots of coarse, rough grass, called twitch, and various other grasses all designated as twitch, but being of several different varieties. All these plants will grow if he leaves them alone, because they are the sort of plants that will grow in land exhausted of fertility; and if he were to sow any kind of seed requiring better soil, the soil would still continue to grow the coarse, wild plants, and the better seed would not germinate, or would germinate and then be smothered by the inferior herbage.

If, however, he puts a covering of manure on the land and then sows better seeds, he will find that the land, being better adapted for the good grass and *less* adapted for the wild grass, the wild grass will diminish and the good seeds will grow, while the roots of the wild grasses will decay and form nourishment for the better grasses.

If, therefore, he starts by manuring the land and sowing a crop of Italian rye-grass to begin with, without cleaning the land, he will obtain a bulky crop, chiefly rye-grass, the first year of its growth. If this crop is eaten on the land, the soil will be enriched by the consumption of the rye-grass, and as Italian rye-grass is an annual, its roots will not grow a second time, and the land may be ploughed up again for a second crop. If for this second crop he selects red clover, which is a bulky, free-growing plant, lasting two years, and if he consumes this crop also on the land, the soil will be still further enriched, and will be fit to receive a crop of permanent grass seeds, such as white clover and dwarf perennial rye-grass, or indeed any of the usual permanent grass seeds.

The advantage of this plan is that, first, none of the natural grasses are eradicated, but as the soil becomes richer the better class of them flourish and the inferior sorts die out; and, secondly, each crop pays its own expenses, and the land does not stand unproductive, but pays its way as it goes along.

The objection to this plan is that it puts an

expense on the crop by having to plough up the land after the rye-grass is eaten off and after the clover is eaten off.

To obviate this, it will be found in practice to answer the purpose nearly as well if the Italian rye-grass, red clover, white clover, &c., are all put into the ground at once. The Italian rye-grass, being the freest grower, will keep back the others till it is consumed and ended, when the red clover, being the next strongest plant, and finding the coast clear, will grow freely, and when it is consumed in its turn, the white clovers and permanent grass seeds will appear on the scene, and, finding the soil in a sufficient state of fertility to supply their wants, will cover the ground with vegetation, which will remain there until the land is again exhausted by mowing and removing the crops without returning any manure.

I need not say that neither the Italian rye-grass nor the red clover should be allowed to seed, but should be eaten down while in flower or before then; while the permanent grasses, when they come, will be all the better for being allowed to seed occasionally, as this will increase the quantity of plants and make the herbage thicker.

This, then, will be found to be an advantageous method of converting arable land into pasture without great expense and without any labour in preparing the soil; and it is not difficult to put it in practice. Italian rye-grass grows early in the spring, and comes

to maturity quickly, and if eaten down by young cattle in good time will allow the red clover to come up the same year. If this is eaten down in the autumn and again in the following summer, or, what is much the same, if it is made into hay, consumed on the farm, and the manure taken back to the field where the clover grew, there will be a fair crop of white clover and permanent grass in the autumn of the second season; and after that, all that is required is to continue to graze it, using for this purpose cattle and sheep combined in preference to either of them alone.

It will also be found an advantage in the case of newly-formed pastures, to graze them *intermittently*, that is, to stock them heavily for a time, and then allow them to grow undisturbed for a time. By adopting this policy, which may not inaptly be termed a 'Hit 'em and hold 'em' system, two advantages are gained; first, it is well known that the roots correspond in size and growth with the leaves and stems; and if these are never allowed to obtain any size, the roots will always remain correspondingly small. Whereas, if the plant is allowed to grow a large top, the roots will become similarly large, and will remain large and strong after the top is eaten. The second advantage gained is, that when the field is heavily stocked, the animals are obliged to eat it all over alike; whereas, if it is only lightly stocked, they will pick out the plants they like best and keep them down, leaving

the coarser and less valuable ones to flourish and seed.

As regards the manure to be applied in the first instance, farmyard manure is the most favourable, as it contains the greatest variety of fertilising substances; and if it should come from a yard where hay has been consumed as well as straw, it will contain a large quantity of grass seeds, which, while detrimental to corn and root crops, only help to increase the coating of herbage when applied to land that is intended for pasture.

Where farmyard manure is not obtainable, the land should be treated with a mixture of nearly equal parts of potash, phosphate, and nitrate, except in the case of clay, where potash is not required.

CHAPTER IX.

ON HIGH FARMING AND LOW FARMING.

High farming is a term very well known to most, and is generally thought to designate all that is meritorious in farming—liberal outlay of capital, large crops, everything in tip-top order, and all the newest improvements either in machinery, implements, or anything else; large outlay in artificial manures, feeding stock with a quantity of food not grown on the farm, but imported or purchased from the manufacturer. These are some of the ideas brought to one's mind by the term *high farming*. Low farming is not a term generally used, the opposite of high farming being often termed bad farming; but I have adopted the term low farming to designate such farming as is not of a kind to be classed as high farming, for reasons I will presently show.

When we want to draw the distinction between good farming and bad farming, which must be the opposite to each other in some sense, we must first settle what we are going to make the *test* of good farming. Spending money on a farm is not necessarily a test of good farming, as it may be spent

ignorantly and wastefully. Growing large crops could only be considered as a test of good farming, if growing large crops *at any cost* were the object desired.

I take it that the test of good farming, like everything else, lies in the amount to which success attends the object to be gained; and as the object of people who have to make their living by agriculture is to make as large a profit *for themselves* as they can, I think the true test of *good* farming as distinguished from *bad* farming is the relative amount of profit for the farmer which is to be derived from it; that is, that any kind of farming which leaves a profit is better than any kind of farming which leaves no profit; or good farming is farming which pays, and bad farming is farming which does not pay.

Judged in this manner, it will be seen that high farming may be either good or bad farming, and that low farming may be either good or bad farming.

High farming, then, is generally adopted by men who have the money to spend, and low farming by men who have little capital beyond their labour and knowledge. High farming is generally to be found on large farms, for tenants with large means will not, as a rule, take small farms. Low farming is generally to be found in conjunction with small farms, for where a man's own labour is an important part of his capital, he loses any advantage to be derived from his own labour when he gets beyond a certain number of acres; and in addition to that, he has not got the

requisite money to take a large farm even at the rate required by low farming.

I must here point out that I am now speaking of tenant farmers only, and of people who have to make a living out of their farming. High farming may easily be met with on a small farm, when the occupier is making a good income out of some other business, and low farming may prevail over a large tract of land, if the occupier is also the owner, but, as a rule, it will be found as I have described.

High farming answers best on bad land and in good seasons. But a man may lose heavily in a bad season where his outlay is very large, and the adverse season deprives him of any advantage from his superior cultivation, when in the same season a small farmer, whose outlay is little or nothing beyond his rent, may not suffer any loss at all.

High farming brings the largest return from the land, and the smallest return per cent. for the money employed.

Low farming diminishes the gross amount produced per acre, but returns a much higher rate per cent. on the outlay in money. A man might make a profit of a pound an acre by means of an outlay of a pound an acre, which is a return of 100 per cent., but no one could lay out his capital on a farm at the rate of twenty pounds an acre, to return him a profit of twenty pounds an acre.

For a man who has a large amount of capital in

money, and wants to rent a farm, it will always be a moot point whether he should take a comparatively small farm and employ a large capital per acre, or spread his capital over a larger farm; or take the smaller farm, but only employ part of his capital upon it, investing the remainder in some other manner. In the first case, he might get, say, 10 per cent. for his capital all round, and in the third case, he might get, perhaps, 20 per cent. on the part he employed in farming, but only 4 or 5 on the remainder which he has invested elsewhere. The second case would probably give him the greatest *gross* return per cent. for his capital, but he would, on the other hand, be standing at perhaps double the rent.

In the case of very poor land, he would be paying a low rent, and would reap but little benefit, if any, from the natural fertility of the soil; he would here then depend altogether for his profits on the amount he expended on the land, and it would obviously be to his interest to put as much capital per acre into the land as he could.

In the case, however, of more fertile land at a higher rent, he is indebted for a considerable part of his profit to the natural fertility of the soil, and in this case it may easily pay him better to farm a larger quantity moderately well, and pay the extra rent, than to spend all his capital on the smaller area.

For instance, if land will only produce one quarter

of wheat to the acre without any manure being bought for it, and can be made to grow two quarters more by means of artificial manure, the expense of labour being the same in both cases, it would obviously be better to grow treble the produce from the same amount of labour, than to employ double the quantity of labour and pay double the quantity of rent to produce only double the produce. In this case, a large outlay in manure would be beneficial if the price of wheat justified the outlay.

If the land, on the other hand, were sufficiently fertile to grow five quarters of wheat per acre without any outlay of artificial manure, and would, as in the first case, grow two quarters more by the application of purchased manure, in this case it might easily be a much better outlay to rent and cultivate twice as much land with the money instead of laying it out in artificial manure, for in one case you would get double the crop, and in the other you would only get two-sevenths more for your outlay.

It will be seen from this that high farming pays in inverse proportion to the natural fertility of the land.

CHAPTER X.

ON TRYING EXPERIMENTS.

Most people who take any interest in their farming, beyond carrying it on solely as a source of profit, will some time or another have devoted a little of their time and attention to trying a few experiments, and very surprising results they sometimes meet with. In this chapter I propose to give a few hints for the guidance of such people, in order to prevent their being, so to speak, deceived by the result of any experiment they may wish to try.

There are two things to be borne in mind—first, that the conditions of the experiment shall be such that you may be as sure as you practically can be that the experiment will answer, if it will answer at all—that is, that it should not be prevented from being successful from some cause which would have rendered its success impossible under any circumstances.

The second is, that you should try the experiment under such circumstances and in such a manner that you may rest assured that the effect produced is produced by the *experiment* you try, and is not due to

some other cause; and this applies equally whether the experiment is a success or a failure, for in one case you might be induced to discard a valuable discovery, and in another case to attach importance to some operation which was altogether worthless. I will give an instance of each, which will show my readers at once what I mean.

A man bought a sack of, I believe, bone-dust, and directed his man to apply it to a portion of a certain crop with a view to finding out if that crop was benefited by its application. When the time came for gathering in the crop there was no difference whatever between the part of the field to which the bone-dust had been applied and the remainder of the field. Hence he concluded naturally enough that, in that particular instance, the application had proved a failure. Some time after he found out that the man to whom he had given the order had emptied the sack of manure into the pond in the field, instead of spreading it on the land.

A second instance was a case in which the owner of the land purchased some draining-tiles and paid his tenant so much an acre to put them in. The tenant soon after left, and it was discovered that the drainage supposed to have been done did no good to the land. On investigation it was found that the tenant had dug holes here and there all over the field and emptied a barrow-load of tiles into each of them. It will be seen that both these experiments

failed from want of caution on the part of the person who tried them.

In the second case I will give two instances in which the experimenter arrived at a wrong conclusion from want of knowledge. They are both contained in letters written to Mr. Pusey, M.P., and published in the earlier numbers of the 'Royal Agricultural Society's Journal.'

In the first experiment the writer of the letter wished to try whether a number of large lambs paid most for a given quantity of food supplied or a similar number of smaller ones. He accordingly bought ten lambs at 35*s.* each, and ten larger ones, described by him in the letter as weighing about a stone and a half more than the smaller ones, at 41*s.* each, and found on selling both lots that the lot of larger lambs left a profit of 5*s.* per head more than the smaller ones. But it will be seen from the weight of the lambs respectively that the larger lambs were worth from 10*s.* to 11*s.* per head more than the smaller ones *when he bought them*, and that as he only gave 6*s.* per head more for them, he had bought them about 5*s.* per head cheaper than the others, so that his profit on the large ones was derived from buying them cheaper and not from feeding them.

In the second experiment the writer wished to ascertain the effect of a salt of potash on a crop of mangolds, and he set to work as follows. He selected a piece of rough old grass on which to try the experi-

ment, and commenced by paring and burning the grass and spreading the ashes over the ground. He then sowed mangolds and top-dressed part of the field with potash, and found no difference in the crop in one part of the field over another. Now this experiment was worthless, because the experimenter was apparently ignorant of the fact that by paring and burning the old grass and spreading the ashes he was giving *all* the field a top-dressing of potash in a highly assimilable form *to begin with*, and all he proved was (what was afterwards found to be the case) that, after a moderate application of potash has been made, a further application is attended with no beneficial results.

It is from considerations like those in the second cause of failure mentioned, that the experiments made by M. Ville are so valuable as a guide. By starting with land in which all vegetable matter had been destroyed, he procured a basis absolutely free from fertility, and, therefore, knew that there was nothing in the soil he made use of except what he put in. This, I need not say, is impossible in experiments conducted in a field; but the experimenter should take care that the soil is in such a state that he will know how much of the result is due to the experiment he tries. For this reason I should recommend an experimenter always to try to get on the further side of his experiment at first. If he tries, for instance, a new fertiliser, it will be better for him to try it in

soil that is already sufficiently fertile to grow a good crop, and then, if the fertiliser causes part of the plot to grow better still, he may be tolerably certain that there is some merit in the fertiliser.

If he wishes to try a new forage plant, for instance, he ought first to try it on highly manured soil, and under the most favourable conditions he can as to time, situation, and season. If the plant will not answer under these circumstances, he need not repeat the experiment; if it does, he can investigate further under the ordinary conditions the plant is likely to meet with.

If he is trying a new breed of any animal, he should feed it as well as he possibly can, and then if it does him no good he should reject it. We often read of experiments which obtained a sort of half success, leading the experimenters to believe that on repeating the experiment under more favourable circumstances it will prove a complete success; whereas, if they had tried the experiment under the most favourable circumstances at first, they would perhaps have had no inducement whatever to repeat it.

The earliest recorded systematic experiments in agriculture are those of Arthur Young, published upwards of a century ago.

They are sufficiently numerous to fill two very large volumes. Many of them are useless at the present time, being comparisons of the different methods of culture as to their relative expense.

These, owing to the totally different cost of labour in the present day, do not afford much useful information. There is one set of experiments, however, which will well repay perusal. I mean those instituted with a view to ascertaining what quantity of seed-corn gave the largest return per acre. Arthur Young concluded that if he sowed a series of plots, each with a fixed quantity of seed more than the one next to it, one plot, or more than one plot, must show an advantage in the crop over the others. He found, as he expected, that a certain quantity of seed per acre gave the largest return, and that the return diminished in a regular gradation as the quantity of seed used receded from the best quantity either way more or less. After repeated trials he found that the yield of barley and wheats diminished in proportion as he receded from ten pecks per acre, that proving the best quantity. But, singularly, he found in the case of oats that the yield diminished both ways as he receded from *thirty-two* pecks of seed to the acre, that is, that a whole quarter of seed-oats gave a larger gross return than any other quantity after the amount sown was deducted. This result is very surprising, and not the least what anyone would have expected.

Since Arthur Young's time there is no record of any long sustained series of experiments till we come to those of Messrs. Lawes and Gilbert, which have extended over forty years, and have been published

from time to time in the 'Journal of the Royal Agricultural Society.' They are too long to recapitulate any of them here, and may be described as a series of thoroughly exhaustive sets of trials of the effect produced by the application of different sorts of manure to both cereal and grass crops.

In addition to these, there are those of M. Ville, Dr. Voelcker, and Baron Liebig, together with a host of amateur experimentalists at various times.

Many experiments were published about the time when Baron Liebig first advised the solution of bones by sulphuric acid in order to render them more readily available to the turnip plant.

Many of these experiments gave an entirely false result, owing to their being improperly tried. People sowed swedes on land containing bones in a raw state and side by side on land treated with dissolved bones; and after taking up the crop in November and weighing it, found that the crop grown on dissolved bones considerably exceeded in weight the crop grown with undissolved bones. They took this without reflection as proof positive that you could obtain a larger crop of swedes by using dissolved bones or superphosphate. If they had reflected, they would have seen that the experiment only showed that the swedes had obtained a larger size by *November*, and if they had allowed them to go on growing till March, they would have found that the swedes grown on insoluble bones went on growing after the others had done; and that dis-

solving the bones, instead of making, as they thought, the roots grow larger, had only made them grow *faster*, which is a very different thing. Wrong conclusions from this cause are numerous. People tried applications of potash on soil which was quite full of nitrogen and phosphorus, but which contained no potash, and found that the application of potash produced immense results, and then extolled the merits of potash as an universal manure, till they tried it again on land that contained no nitrogen or phosphorus, when they collapsed. Some of these experiments remind one of the story of a youth who came home in a state of intoxication, and informed his mother that he had been trying an experiment on the intoxicating powers of different spirits, and found out that whisky possessed the highest intoxicating power. This experiment, to use his own words, was conducted as follows:—'First, I drank three glasses of gin—sober as a judge. Then I drank three glasses of brandy—no go. Then I drank three glasses of whisky—off directly!' Probably, if he had preceded the three glasses of whisky by six glasses of water instead of six glasses of other spirits, the effect of the whisky would not have been quite so marked.

The most expensive class of experiments that can be tried on a farm are, I need hardly say, those connected with the introduction of new kinds of machinery and implements; and as there are always plenty of experimental farmers who farm chiefly for amusement and occupation, ready and willing to give anything new a

fair trial, I should recommend anyone who was farming for an income to let this class of experiments alone. There is one great objection to employing any new implement when first introduced, and that is that they have rarely arrived at the highest perfection they are capable of; and although they may be a decided success, still, if anyone invested their capital in them, they would probably find that before long a still better one had been introduced, and that they were in the unpleasant position of either having to go on using an inferior machine, or else buy a second, in which case all the money laid out in the first would be wasted. I need not say that this objection does not apply to hiring, but only to buying new implements.

There is yet another class of experiments which I have not yet treated of, and that is, as connected with the breeding and feeding of animals. I propose to treat of these subjects in a separate chapter, and will only point out here that all attempts to in any way alter or improve an existing breed, partake necessarily of the nature of an experiment.

CHAPTER XI.

ON THE DIFFERENT VARIETIES OF SOIL.

Soils are generally classified by writers according to their geological rather than their agricultural qualities, and for this reason the classification is of little or no use. How much better is an ordinary farmer for being told that a farm he is about taking is on an oolite or a trap formation, or a tertiary deposit, and so on? If he knows nothing of geology, the terms are incomprehensible to him, and if he be acquainted with geology, the information is superfluous.

Agriculturally speaking, most soils consist of one of the five following sorts: clay, sand, loam (which is a mixture of clay and sand in various proportions), limestone, and black or peat soil.

Of these, clay grows corn the best; sand, if of good quality, grows grass the best; loam grows leguminous plants best; limestone grows roots, and peaty or black soil potatoes. Clay requires to be supplied with nitrogen, sand with potash and phosphorus, and peaty soil with lime, in order to grow good crops. Loam and limestone do not appear to require any one kind of manure more than another.

Loamy soil, combining both clay and sand in fairly equal proportions, will grow any crop that sand alone will grow and any crop that clay alone will grow, and in addition to these two, it will grow luxuriantly some crops which will not attain excellence either on sand or clay alone.

For this reason, loam is the most popular soil to farm, and commands the highest price to let.

Peat, on the other hand, will grow nothing of value until lime has been applied to it to decompose the vegetable matter of which it is principally composed. When this is done, it will grow pretty nearly anything. There is no soil occupying a position midway between peat and limestone in the same manner that loam occupies a position midway between sand and clay. But lime is often added to peat artificially, while limestone acquires a certain amount of vegetable matter from the growth and decay of plants, which are rapidly decomposed by the lime, and the required mixture is produced.

Hence limestone has a tendency to become more fertile by cultivation, clay remains stationary, and sand has a tendency to relapse into its original state unless it is kept up to the mark by the constant application of manure, which application is made either by carting manure on, or else growing a crop and consuming it on the land, as in the case of grass or turnips, in which case the fertility of the soil is kept up, or increased according to the extent to which

this is done. Where a crop is grown with extraneous manure, and then eaten on the ground, the fertility of the soil is invariably improved in the case of sand land and of limestone, but not so greatly in the case of clay.

My readers must not understand that in the above summary it is asserted that sand will grow better grass than loam or clay, or that limestone will not grow corn. The meaning is, that sand will grow grass better than sand will grow corn; clay will grow corn better than clay will grow roots; limestone will produce larger proportionate weights of roots than it will of cereals with the same treatment, and so forth.

Hence it follows that, in making any modification of the prevailing or four-course system, it will be well to pay considerable attention to the peculiar kind of soil on which the change is proposed to be made, and to adapt the rotation to the individual characteristics of the soil. Thus on light sand the change in the four-course system should take the form of leaving the field down in grass for two, three, or more years before ploughing up for wheat. In peat soils, potatoes may be introduced occasionally, in the place of a cereal or corn crop, with advantage, while in the case of rich loam it will often be found that a crop of cabbages will fetch considerably more money than a crop of wheat, owing to the fact that loam is specially adapted for the growth of this vegetable, which many

other soils are not. Clay, on the contrary, will produce, as a rule, more money when sown with a corn crop than when sown with any other crop, providing the corn is sown at the right time, and the soil is sufficiently pulverised. Hence, a greater profit may be obtained from clay soils by growing wheat oftener than you are able to do on other soils; the capacity of clay for bearing cereals being greater, and the expense of cultivating the land for the intermediate crop of roots being heavier than on sand.

There is a great difference between the treatment to be pursued with clay soils and sandy soils respectively.

Sandy soil is a good servant but a bad master. If you keep it constantly at work at growing something useful, and supply it regularly with nourishment in the shape of manure, it will grow a fair crop almost independently of the weather, and it can be cultivated at all times, and applied to growing almost anything. But if it be left to itself, or forced beyond its natural capabilities by overcropping, it will develop every vice that a piece of land can be said to be capable of.

In the case of a clay soil, on the contrary, the relations of the farmer to it should be somewhat similar to his relations to his landlord.

If he approaches it at a proper time, and in a proper manner, he can often obtain a good deal from it, without any great outlay on his part; and, even if

his demands are somewhat excessive, it will still behave to him in a liberal manner. But only let him try to plough it when it is wet, or at a wrong time of the year, and it will behave somewhat as follows:—

It will come as hard as a brick floor, and break out all over large cracks something like a pane that has been starred by having a stone thrown at it; or it will resemble a field that has had cartloads of bricks shot down, and spread all over the surface.

Or it will cover itself with a large-leafed running plant, something like a tobacco plant, but without the useful properties of the latter; or it will clothe itself with a coating of wild yellow annuals, as thick as if they had been sown by hand, although the farmer may know by experience there has not been any plant of that sort allowed to seed for many years; or it will have patches of twitch all over it, as if it had the measles.

In Pliny's letters on agriculture, speaking of some soil in the neighbourhood, he says, 'that if wheat is sown on it at a particular time of the year, it will come up oats,' but he does not attempt to explain the phenomenon. This soil, though he does not say so, would doubtless be clay, and the explanation of the phenomenon is to be found in the fact that the wheat would not grow at all if sown at that time of the year, and that the clay amused itself by growing a crop of wild oats spontaneously, whenever it was in want of something better to do.

PART II.

CHAPTER I.

ON BREEDING ANIMALS.

How many people, I wonder, have tried their hands, at some time or another, at breeding animals, not so much with a view to producing greater numbers, but to improving the race of those animals they condescended to turn their attention to?

How many enthusiasts have set out joyously on their journey with an old-fashioned sow, which would feed up to thirty stone, eat anything, and produce from twelve to twenty pigs at a litter, and by careful selection and unwearied attention arrive at the end of their journey (as far as pig-breeding is concerned), the happy possessor of an animal half the weight of its ancestor, whose flesh is all tallow, who can only live on the best of food, and requires that to be put into its mouth, and who produces one pig at a time, which invariably dies?

How is it that if you want a shorthorn bull of a good strain you have to give a thousand pounds for it, when from the time, and attention, and money that has been spent on them they ought to be as plentiful as blackberries?

Is it because it takes four two hundred and fifty guinea cows to produce him, while it takes six such animals to produce enough milk to rear him? and if so, how is this disastrous result brought about? How is it that cart-horses, which have had no sort of attention paid to them, are the finest-looking, largest, and best-shaped horses in the world, and perfectly able to perform the duties required of them, while race-horses, after all the time, and money, and care bestowed on them, are, *as a class*, the worst shaped, most undersized, and most useless of any breed of horses, and very often cannot even gallop, which is about the only thing they are wanted to do? It is not so very many years ago that a turf authority, when the advisability of having a new four-mile race was discussed, gave it as his opinion that there were not half a dozen horses at Newmarket that could gallop four miles *at all*.

Such are the questions which naturally occur to one when contemplating this topic. Let us try and unravel the mystery.

To begin with, when we talk of breeding animals it is understood that rearing as well as producing them is meant. Rearing them means housing and feeding them, but principally feeding, while producing them means selection of the animals to breed from, both male and female, but principally the former. Here we have two elements of departure to start with. It is obvious that if we select animals to breed from

worse than the average, we shall deteriorate the race, that is, make it worse than it would be if left to nature; and if we select better animals than the average to breed from, we shall improve the race, that is, make it better than it would be if left to nature. Similarly, if we supply animals with worse food than they would get under ordinary circumstances we deteriorate the individual, while if we supply them with *better* food than they would otherwise get we improve the individual. It is much easier to injure or improve the race by good or bad selection than by good or bad feeding; and it is much easier to improve or deteriorate any one individual animal by judicious or improper feeding than by any selection you may have made of its parents.

Animals of a well-selected race may, however, be starved and badly housed for two or three generations, and still they will do ample justice to better treatment when they can get it; while an animal that is descended from badly-selected ancestors, although it will do better on good keep than on bad keep, cannot be made to compete on equal terms with one that has been well selected. Hence good selection is of more importance than good treatment, and ought to come first where a race is concerned.

I need not point out that the greatest amount of harm will be done to a breed where bad selection and improper feeding have *both* been brought to bear on it, while the greatest amount of good will be

attained by the combination of good selection to start with and judicious feeding to follow up with.

We come to the conclusion, therefore, that when an artificially bred race of animals is found to deteriorate, it is certainly due to improper selection, or to improper feeding, and it is possibly due to both.

If we start with a breed of animals about whose former history nothing is known, and select all the best males and females to breed from, and supply them with better food than they have heretofore had, we shall produce better animals, and these animals will go on improving under this selection and treatment until they have attained the maximum of excellence they are capable of attaining to; but it will be found that the improvement will take the form of there being less bad ones in proportion to the good ones than there were before, rather than to the best specimens being very superior to the best specimens of the unimproved race; and for this there is a reason. Out of a number of the unimproved race there will be *some* descended from the best parents, and *some* that have somehow got plenty to eat, and these few will therefore have been bred and reared under conditions as favourable as those under which the improved race exist. But instead of these conditions applying to the whole herd or flock, they only apply to a small part which have accidentally derived advantages similar to those which the breeder strives to apply to them all. The first advantage, therefore, which ought to be

attained by good selection and good treatment will be to diminish the difference between the best and the worst specimens, or, in common parlance, to make the breed more level.

When this effect is fairly accomplished, the breed can be modified, or perhaps, I may say, improved in any particular direction, either by selecting animals with a tendency in the direction you want, or by modifying the conditions under which you rear them. Thus the size of a herd or flock may be increased by selecting the *largest* animals to breed from. Their tendency to fatten may be increased by always breeding from those who are most given to lay on flesh; while, on the other hand, a stronger constitution may be imparted to them by allowing them to run out instead of housing them, and activity may be engendered by causing them to seek their food instead of having it brought to them.

The above comprises pretty much all anyone can do in the way of improving a pure breed of animals without diminishing or altering its purity, that is, without mixing it with any other race. When, however, the attempt is made to improve any breed by intermixing it with any other breed, or to get up a breed which shall contain the blood of several races of animals, a much wider field of enterprise is opened; while at the same time the amount of skill, attention, and judgment required in order to produce successful results will have to be very much more than in the

former case, and the probabilities of failure very much greater.

There are two notable instances of success attending the efforts of two eminent breeders of sheep, one of whom adopted the first and the other the second of the systems I have mentioned.

Mr. Jonas Webb, of Brabaham, devoted the greater part of his life to the improvement and development of a well known and old established breed of sheep, the Southdown, and left a flock of sheep very much superior to those with which he started, but still remaining precisely the same breed of sheep, and retaining their original blood in all its purity.

Mr. Bakewell, of Dishley, on the contrary, proceeded, as far as we can gather from the scanty information afforded of his operations, on the lines of the second system. He started apparently without any partiality for a particular breed, and selected the animals possessing the qualifications he wanted from almost any breed, and intermixed them indiscriminately, and at the end of a quarter of a century had established a breed which previously had no existence, and which differed in many important characteristics from any known race. The New Leicesters, as they were called, differed from any sheep previously seen. They had the *quantity* of wool of the Lincolns, the fineness of wool almost of the Merino, and the aptitude to fatten of the Southdowns, and were found to possess the important peculiarity of mixing well with almost

any other breed and improving them; that is, that whatever breed the flock of ewes were, if you put them to a Leicester ram, the progeny were better than their mothers. In the course of a century these sheep have overrun the whole face of the country, and infused their blood into pretty nearly every white breed of sheep. It may happen, however, that in process of time this breed will disappear in much the same manner as it came into existence, that is to say, that the breed will be found mixed with many other breeds, but they will have the distinctive marks of the other breeds and not of the Leicester.

We will, however, for the present, leave this part of the subject, and see how best to set about improving a breed without any admixture of fresh blood. The first thing I should point out is, that symmetry is of more importance than size in selecting the animals to breed from. The size of an animal is governed partly by the size of its parents, and partly by its being well fed, or the reverse. It is possible to obtain an animal larger than either of its parents by good feeding; but no feeding will make a well-shaped animal from badly-shaped parents. After symmetry is pretty well established, the breeder should consider what improvement he wishes to produce, that is, for what object he is breeding, and this is where many breeders break down—they do not know what they are breeding for.

A distinguished military writer on horsemanship

commences a chapter on managing the reins as follows:—

'When you want the horse to turn to the right, pull the right rein, when you want him to turn to the left, pull the left rein. This is common sense, the contrary is common error.'

This should be borne in mind by breeders who, when they wish to obtain a particular object, should take the means most likely to do so.

If they want to breed a white calf, they should select a white cow and a white bull; if they want large animals, they should choose the biggest animals to start with, that are, in other respects, good enough for them, and so on.

It is a very common practice, and I think quite a wrong one, for people, if they have an animal extremely good in one point and indifferent in the rest, to mate it with an animal extremely good in a *different* point but faulty elsewhere. This is a fruitful cause of disappointment, for out of four different results which may occur, only one would be satisfactory, that is, the animal might be like its father, like its mother, have the bad points of both, or have the good points of both. A breeder should rather go on the plan of not throwing anything away; and if he has a cow or a sheep very good in one point, he should not risk losing this merit by putting her to a male that is bad in the point where she is good, but should rather choose the most symmetrical animal he can

get. Where a man has several animals of both sexes to choose from, he should always put the best males to the best females, and the worst females to the biggest males, for a large bad one is worth more than a little bad one. If he puts the best shaped females to the largest males, he might lose the shape without gaining the size, and if he put the smallest and worst females to the best shaped males, he would, perhaps, gain neither size nor shape. The great cause of failure, however, may be traced, I believe, to the practice of selecting animals from their pedigree in preference to their shape, size, and qualifications. Where no record is kept, as in the case, hitherto, of sheep and cart-horses, the animals have to stand on their own merits, as nothing else is known about them, and the *best* animals are selected.

As soon, however, as a herd-book or stud-book appears on the scene, people are tempted to go more by the pedigree than the qualifications of the animal, that is, they often select an animal from the merits of its ancestors in preference to its own merits. They should, in this case, bear in mind the rule I have quoted about the bridle reins, and not choose an animal by its pedigree alone, unless pedigree alone is the thing they want to obtain. They may depend with tolerable certainty, if they breed from a bull or a cow of undeniable blood, on getting a calf with a good pedigree, *if that is all that they want*, but if they want *anything* else, they may be wofully disappointed.

They should also remember that the production of beef and mutton is the ultimate object of producing cattle and sheep, and that, to take a slight liberty with the Poet Laureate's writings—

> The butcher at the auction mart
> Smiles at the claims of high descent,
> Broad backs fetch more than pedigrees,
> And inside fat than duchess blood.

It has always been a disputed point whether the improved shorthorn of the present day is a mixed breed, like the Leicester sheep, or a pure race, like the Southdown. Mr. Bates, the greatest breeder, perhaps, that there has been, held a decided opinion that the pure shorthorn was a distinct race, of which his own herd were the best specimens, but that a great number of pedigree cattle, entitled pure shorthorns, contained an admixture of other breeds. I should be inclined to agree with him in this, and I should also imagine that the proper colour of a shorthorn was roan, or red and white, for this reason, that roan is never found in any other pure breed.

The principal breeds of England would, I think, originally be confined to four: the wild or white cattle, which were the largest; the roan or shorthorn the next; the brindled or longhorn, and the red breed, taking in Devons, Herefords, Sussex, &c., and that if a shorthorn is red, brindled, or white, he has in him some of the blood of one of the three other breeds. There are many people who have herds of so-called

pure shorthorns of a whole red colour, and I have always noticed in these herds a tendency to grow smaller and more and more like the Devon breed, and less and less like the roan shorthorns; while, on the other hand, the largest specimens are generally to be found among the white ones. White is a colour which is disliked, and white herds are not much kept; but if the white animals and the red animals out of a shorthorn herd of mixed colours were to be selected, and bred from separately, in a few generations they would acquire all the appearance of two distinct breeds, the white being larger than the shorthorns and the red smaller. I believe it is a fact that every shorthorn in the herd-book is descended from one bull called Hubback. This bull was a small-sized, good-shaped bull, of a yellow-red and white colour, with a remarkably soft and pliable skin, and a great tendency to fatten rapidly, and his stock appears to have been so far superior to any other, that his blood came to be infused into every herd of shorthorns in the kingdom, his own pedigree, however, being unknown. There is a similar instance in the stud-book in the case of the Godolphin Arabian, who was bought out of a water-cart in Paris, and looked upon as an animal of little or no value, until his stock were found to be better racehorses than any other breed.

The dam of Hubback belonged to a cottager and grazed with her calf on the roadside, and Hubback

was, the accounts of him say, sold for a sovereign as a calf, to a blacksmith. Excepting in size it is probable that no better animal has since been produced than he was, and from him all the duchesses are descended which have fetched the highest prices in England and America.

It will be seen here that the only value of a pedigree consists in being able to trace back a descent to an animal whose pedigree was unknown, and if the herd-book had been in existence at the time that Hubback was alive he would probably have been rejected for want of a pedigree, and the finest race of cattle in the world (those descended from him) would not have existed.

I mention this to point out that where anyone, as is often the case, wishes to breed cattle for ordinary purposes, he will do better to choose an animal of the sort he wants to produce, but without a pedigree, than an inferior animal whose descent is recorded; and it is from *not* following this course that so many failures in breeding have occurred.

We now come to the second system of improving a breed by intermixing it with other breeds, and thereby altering its character.

The advantages attending this process are twofold: first, that cross-breeding, as it is called, has a tendency to impart a stronger constitution and improved size, irrespective of any merits of the parents; and, secondly, by selecting the best animals from different

breeds to start with, and picking out the finest specimens of the progeny, it is possible to combine some of the merits of both breeds, and get animals which are superior to the best specimens of either breed, in *something*. Let us again take sheep. The Southdowns produce the best class of mutton, and fatten rapidly, but are deficient in size and have little or no wool. The Cotswolds are, on the other hand, a breed of large size with plenty of wool, but fattening slowly, and not being of such good quality, as far as mutton is concerned, as the others. By breeding from both these breeds, and then selecting the best specimens and breeding in future from them, a new breed of sheep has been formed, having many of the merits of both races. This breed is called the Oxfordshire Down. Another similar instance is the establishment of the Border-Leicester from the Cheviot and the Leicester. It was found that the Cheviot sheep, which were the right sort on unenclosed land, at little or no cost for rent or cultivation, were not valuable enough for the farmer to keep when he came to adopt the alternate system of husbandry; and the Leicesters, on the other hand, were too delicate to stand the climate which suited the Cheviots. By, however, combining these breeds, they got a sheep hardy enough to take the place of the Cheviot and sufficiently valuable and quiet in its habits to answer as well as the Leicester.

I may here observe that it is generally receive

as an axiom in breeding that an animal inherits its constitution from its mother and its appearance from its father in a greater degree than the reverse. Hence, where you wish to introduce the blood of a race from a different climate the males should come from the different climate and the females from the place where the flock is going to be. This is what has practically happened. The Southdown or Sussex ram has modified the flocks in Gloucestershire, Worcestershire, and Norfolk; the Leicester ram has modified the Lincoln and the Cheviot in the east and north of England; and the Cheviot ram has modified the black-faced sheep in Scotland.

Where there is no particular difference in climate and a man wishes to mix two races he should buy the females that he can get the cheapest, as he will have to buy several females for one male, and he will get a bigger flock for the same money one way than he will the other; but he should take care not to avoid the common error of buying a number of inferior animals and paying more for them than he would have to pay for a better description of animal at home.

CHAPTER II.

ON CATTLE.

I PROPOSE in this chapter to give a short description of the different principal breeds of cattle in this country, comparing them with each other.

The shorthorn would naturally occur first to anyone's mind who is conversant with cattle as being the breed most generally known, most widely spread, that is, occupying a larger area than any other distinct breed, and as furnishing, as a rule, the largest and finest specimens of the race of cattle. These cattle may be said to have had their origin in the county of Durham, from whence they have spread over the whole of the north and north-eastern part of England.

The Herefords probably come next in numbers, occupying the greater part of the rich grazing lands in the Midland Counties. The Devons people the south-west parts of the country, and the Sussex the southern; while in the Eastern Counties a polled breed, the only English polled breed, is to be found.

Besides these, there is the longhorn, a remnant now comparatively small of the large breed of cattle

which probably peopled the north-west of England when the Durham, or shorthorn, breed was still confined to its native county.

This breed is now chiefly to be found in Warwickshire and Lancashire, and might probably be used with advantage to give a change of blood when required to some of the other breeds, being, as it is, more distinct and less intermingled than the other breeds I have mentioned.

Of these breeds the shorthorn is the largest, the longhorn and Sussex the next, the Hereford and Suffolk polls the next, and the Devons the smallest.

As regards colour, shorthorn comprises by far the greatest variety f colour, and is, I believe, the only one of the breeds I have mentioned numbering among its colours white and roan. Of the others, the Herefords are all red with white faces, and the Devons, Sussex, and Suffolk polls are all red breeds. The longhorn, judging from the specimens shown, are all either red and white or brindled and white, but principally the latter.

The shorthorn numbers in its ranks red, red and white, roan, and pure white. This great variety of colour, perhaps, is the reason why many people look on the shorthorn as a mixed or mongrel race; but it is most likely the case that there is a pure race of shorthorns, just as much as there is a pure race of any other breed of cattle; but that the shorthorn numbers in its ranks a great number of animals that

are descended from other races, and that are by no means a pure breed.

There are two reasons why this should be the case ith shorthorns more than any other breed. One is, that from the variety of colour prevailing among them, it is much more difficult to detect any admixture of foreign blood. Thus, take the case of an animal partly Devon and partly shorthorn. If this animal were to have a trace of any other colour than red, it would immediately be rejected by the Devon breeder as not being a pure Devon, even though it resembled the Devon breed in everything else than colour.

But if this animal, instead of resembling the Devon breed in size, shape, and length of horn, resembled the shorthorn breed in those points, but was of a pure red colour, the shorthorn breeder could not tell by its colour that it was not a pure shorthorn; and thus many animals might come to be called shorthorns which were by no means pure shorthorns.

The second reason is, that while all the other breeds are still chiefly confined to the districts they have always occupied, the shorthorn breed has penetrated into all parts of England, and has by this means got intermingled with all the other races. For this reason we should expect to find the purest specimens of shorthorns in the county where there has been no other breed to mix with; and this would, no doubt, be the case, were it not that the pedigree shorthorns have become so fashionable and so high in price, that bulls

are sent from one end of the kingdom to another, and a herd of pedigree shorthorns in Durham is as likely as not to be bred from an animal fetched from a shorthorn herd in Devonshire or Sussex. Paradoxical as it may seem, the fact of the pedigree shorthorns being entered in a herd-book, while it enables a man to secure an animal of any particular strain or family, makes it more difficult for him to be certain he has obtained an animal with nothing but shorthorn blood in his veins.

If a man wants a number of, say, West Highland, or Galloway, or Jersey cattle, he can go to the homes of these breeds and be tolerably certain of getting them pure, there being no other kind of cattle in the districts respectively where they are bred.

If, however, he wants to find a tribe of Galloways or a tribe of Jerseys superior to the other Galloways or the other Jerseys, he has nothing to guide him in picking but any skill in selection that he may possess himself.

In the case of shorthorns, on the contrary, a man can obtain members of any particular tribe or family without difficulty, but if he simply wants to get a drove of pure bred shorthorns at a fair market price he will hardly know where to go to look for them.

The Jersey and Guernsey cattle, formerly called Alderneys, come, as may be supposed, chiefly from the islands of those names, where the breeds are kept up in a high state of purity. There are a few pure

Jersey herds in England, but the greater part of these cattle are imported, and breed when here half-bred calves, the heifers of which are kept for breeding and the male calves generally sold at a low price as calves. By this means there is a constant infusion of Jersey blood going on into the cattle of this country; and as the Jerseys are supposed to be good milkers and bad feeders, they seldom get sent to the butchers as maiden heifers, which is often done with shorthorns.

The Jersey cattle are supposed to be tender and bad to feed, but, as far as my own experience goes, they are just as hardy and just as able to take care of themselves as any other breed; but their small size prevents them from being much valued for anything but milking.

There now remain the Scotch breeds. These may be roughly divided into two classes—those with horns and those without horns; the latter, or polled breed, being again divided into two leading tribes, the Galloway and the Angus, or Aberdeen. The prevailing colour is black, but in the horned breeds, such as the Skye or West Highlanders, red and dun are often met with.

As regards the milking properties of the various breeds, the widest divergence of opinion is held; but one fact appears to be pretty clearly established that the Jerseys and Guernseys are the best milkers, giving the richest milk, and the pedigree shorthorns, taken altogether, are the worst, many of them not

being able to rear their own calves. This fact is, I think, easily accounted for. The shorthorn cattle have been raised almost exclusively for the purpose of producing shorthorn bulls, and in these animals a tendency to fatten early and quickly has been the sole desideratum sought for.

The Jersey and Guernsey breeders, on the contrary, look solely to the sale of their cows for profit, bulls being seldom exported, and, therefore, have bred solely with a view to milking properties. In course of a long lapse of years, by constantly selecting animals with these two qualities respectively, the appearance and properties of the two breeds have diverged accordingly. Of the other breeds I should say that in regard to their milking properties there is quite as great a divergence between animals of the same breed as there is between one of the breeds and another.

CHAPTER III.

ON SHEEP.

We now come to sheep, the next, or perhaps the equal of cattle, in importance.

Of these formerly there was a different breed in nearly every county, but since the introduction of the improved Leicester breed by Bakewell, and its widely-extended growth, a great number of the original breeds have disappeared.

We still, however, find broadly-marked distinctive features in the breed prevailing at the present day in the different districts of the country.

In the counties where the Devon breed of cattle prevail we find a horned, white, short-woolled breed called Wiltshire, Somersetshire, and Dorsetshire. In the west of England we find two mixed breeds of sheep, the Oxford Down and the Shropshire Down, and one pure old established breed, the Cotswold; in the north-west, the Masham breed; in the north of England, the Cheviot, a pure breed, and the Border Leicester, a mixed breed; in Yorkshire and north of the Trent, the Leicester, which is also all over the

country, and occupies the same position among sheep as the shorthorn does in cattle.

South of the Trent, in Lincolnshire—and Lincolnshire only—we find the sheep known as the Lincolnshire sheep. All along the southern coast the Down breed of sheep prevails, classified as the Southdown and Hampshire Down; and in the southern of the Eastern Counties we find a breed partly of Down and partly of the old breed of those counties; and in Scotland we find the blackfaced horned sheep. There are also various breeds of moor or mountain sheep, most of them with horns, wherever moors and mountains are to be found.

I will recapitulate the breeds I have named, and then give a short description of them and an account of the history of each:—

True Breeds.—The Lincoln, the Cotswold, the Leicester, the Cheviot, the Southdown, the Hampshire Down, the Dorset, the blackfaced Scotch, the whitefaced moor sheep.

These are all pure breeds, with the exception of the Leicester and Hampshire Down, which some people would describe as mixed breeds. I should, however, be inclined to think they are entitled to be classed as pure breeds.

Mixed Breeds.—The Oxford Down, the Shropshire Down, the Norfolk sheep, the Masham, the Border Leicester.

The above are all known to take their origin from

two of the former breeds, but are now bred from *by themselves* in sufficient quantities to entitle them to be called a distinct breed, though not a pure breed.

I need hardly point out that there are a great number of crossbred lambs produced every year by the admixture of two of the above breeds in various ways, but which are not afterwards bred from in sufficient quantities to justify them in being called a breed.

The Lincolnshire sheep are now being crossed pretty freely with Hampshire Down rams, the produce being something resembling the Oxfordshire Down, but with longer wool. These sheep have not yet been bred from, but if selected and bred without further crossing, would in all probability form a valuable breed, and would correctly be described as a Lincolnshire Down.

To the Cotswold sheep is generally attributed the honour of being the oldest breed that anything authentic is known about, and was supposed to be the largest breed in England. I think, however, the merit of being the largest breed, as far as weight, will rest with the Lincoln sheep, the Cotswold appearing to be longer on the leg, and yet no higher altogether. If a prize were to be offered at the Royal Show for the heaviest sheep in the yard, irrespective of age, sex, or breed, the competition would furnish some very interesting and useful particulars as to the weights up to which the different breeds can be fed.

The Cotswold sheep, then, is a large, imposing,

up-standing sheep, with a more stylish and airy carriage than the Lincoln, generally furnished with a top-knot or tuft of wool between the eyes, and feeding to a great weight, but not clipping so much wool as the Lincoln.

The Lincoln sheep is a massive, compact, solid-looking sheep, bearing the heaviest fleece of any breed known, shearling rams often clipping from twenty to twenty-five pounds of wool, and some few as high as twenty-eight pounds. It will be seen from this that when wool is at a high price, say fifty shillings per tod of two stone, the *fleece* of a Lincolnshire sheep will often sell for as much as a whole sheep of another breed. For this reason, when wool is dear, the Lincoln sheep are most valuable; but when wool is low in price, as much money can be made out of other breeds. The value of the Lincolnshire sheep may therefore be said to rise and fall with the price of wool, whereas the value of other breeds as a rule rise and fall with the price of mutton.

The Leicester sheep, which is now getting very much crossed with the Lincoln, is a smaller sheep than the Lincoln, clipping less wool, but feeding much quicker, and putting on a much greater proportion of fat.

The Cheviot, the next sheep on the list, is a totally different looking animal, small in size, with large eyes and closely-set wool resembling fur. It is not at all the sort of sheep one would expect to find in such

northern situations. In size, a Cheviot ewe is about as large as a fine Lincolnshire lamb is when weaned.

The Southdown is a very similar breed to the Cheviot in size, but feeding quicker, and of a different colour, being a light brown or copper colour, while the Cheviot is pure white.

The Hampshire Down is a large, long, flat-sided sheep with an ugly black head and black legs, and the same colour as the Southdown. The Hampshire Down is a larger, rougher, and probably hardier breed than the Southdown, and is for this reason preferred to the Southdown for crossing with large breeds like the Lincoln and Cotswold. For crossing with the pure Leicester and the Cheviot, a Southdown would be preferable.

The Dorsets are a horned white breed about the size of the Leicester, with wool like the Cheviot. They are said to breed two crops of lambs in a year in their own county, and when transported to other counties will breed lambs three times in two years. Excepting for producing early lambs for the London market, they do not seem to possess any great merit to induce anyone to keep this breed, out of their own county.

The blackfaced Scotch and the whitefaced moor sheep are both horned, and their sole merit appears to be that they will live where other sheep would starve. They are quite unfit for an enclosed country, as they will leave the field they are put into, and go to the field that appears to them most suitable

within a mile or so, which field, as likely as not, is a field of clover belonging to someone else, and laid in to mow.

We now come to the mixed breeds.

Of these the Oxford Down is a mixture of Cotswold and Hampshire Down, and the Shropshire is a mixture of the Hampshire Down with a long-woolled white breed formerly found in Shropshire, but now probably extinct.

There is not a great difference to the inexperienced eye between these two breeds, but the Oxford Downs are rather the largest and longest-woolled sheep—they are larger than Leicesters and less than Lincolns. The Masham is, I believe, a cross between the moor sheep and the Leicester, and the Border-Leicester a cross between the Cheviot and the Leicester. The Masham sheep are smaller than the Leicester, but the Border-Leicesters are as large, or larger, than the true Leicesters. There is another variety of sheep something like Border-Leicesters, but coarser and larger, which prevail in the North of England, and probably are a cross between the Cheviot and the old Teeswater breed.

CHAPTER IV.

ON PIGS.

THERE are several varieties of pigs still to be found in England, but the number of those varieties, as in the case of cattle and sheep, is smaller than it was, and is diminishing, and the principal breeds now to be found are reduced to four—the large white breed, the small white breed, the small black breed, and the Berkshire.

Of these the old large white breed is a lop-eared, large-boned, long-framed animal, arriving slowly at maturity, but feeding to great weights. The modern large white breed I should be inclined to describe as the old large white breed with as great an intermixture of a small breed as it will stand without being altogether transformed into a small breed.

The small breeds, both black and white, are originally descended from Chinese or Neapolitan pigs, and the Berkshires appear, like the old large white, to be a pure breed. The Berkshires are generally black, with white feet, just as the Hereford cattle are red with white faces. Probably the white feet, like the white faces, confer no extra merit on the animal, but it is

useful as a means of identifying and so keeping up the purity of the breed.

Of these the large white breed are the most useful where food is plentiful and time no object, as, for instance, on large farms where a number can be kept. The middle or improved white breed is useful for cottagers, where only one or two are kept, and the small black and white breed are mostly found in the possession of people of independent means, who have little or no land in their own occupation.

The Berkshire is more confined to one locality than to one class of people.

In the case of the three first named there is a reason for their being thus classified, which would not strike anyone at first.

The bacon on large farms is the main food of the farm-servants, as far as meat is concerned, and a pig that will produce meat as much like beef as possible is the most desirable, as it takes the place of meat. The small breeds of pigs are chiefly bred by people who only consume a small proportion of bacon in conjunction with other meat, while the cottager wants a pig as like the large breed in its flesh and as like the small breed in its habits of life as he can get, and this he procures by feeding an animal descended from both breeds.

CHAPTER V.

FARM-HORSES.

CART-HORSES play such an important part in the economy of every farm, that some observations about them will not be out of place in a book treating on any matter connected with agriculture.

In my other work, 'Horses and Riding,' I have dwelt at some length on the choice and management of horses generally, but have not devoted any part exclusively to horses used in agriculture.

One of the earliest books now in circulation which contains anything on this subject is Youatt's 'Book on the Horse,' which not only gives a description of the breeds which then were chiefly in use, but also contains a treatise on draught.

As far as I can judge, most of the books on farming subjects which I have seen, which contain any matter relating to farm-horses, and which have appeared since Youatt's book, have followed, so to speak, in the same groove, and made the same or similar statements.

Youatt's book contains some statements which are, in my opinion, totally incorrect, and which, al-

though perhaps not to be wondered at when you consider the rude and imperfect state in which the science of agriculture was when he wrote his book, ought long since to have been discarded by other writers who had better opportunities of arriving at a proper conclusion than Youatt had.

Youatt's book, in describing the qualifications of a good horse, places as one of the principal requisites for a good hunter, or indeed a good riding horse of any kind, that he should be possessed of a sloping shoulder.

This is right, but he goes on to say that, 'When the shape of a horse for harness is considered, the case is different; in this case, a sloping shoulder is of no consequence, and indeed in the case of heavy draught horses an upright shoulder is an advantage.' This is wrong, and it is surprising how many times this statement has been repeated in other works.

The reason generally given in support of this fallacy is that a horse with a straight shoulder is better able to throw his weight into the collar; and I not long ago saw it confidently asserted that *all* draught was nothing but throwing the horse's weight into the collar.

A moment's reflection ought to convince anyone that this idea is altogether erroneous.

A cart-horse weighing less than half a ton will draw on a good road a cart weighing about 13 cwt., with nearly, if not quite, a ton of something else on

the top of it. Now, how could the horse possibly even *stir* this load by throwing his weight into the collar, much less take it along the road a considerable distance at a very fair pace?

A cart-horse pulls a load in the same manner, precisely, as that in which a man pulls a garden roller, and that is by an exercise of muscular strength by partially bending his legs, and then straightening them again.

It is true that in order to do this he often, especially in pulling a heavy load, leans forwards, but this is because that is the position which he finds to be most favourable for exercising the necessary bodily strength. It is true that a heavy horse can pull a greater weight than a light one, but this is because a big horse is stronger, and can pull a heavier weight than a little one, and a heavy horse is bigger than a light one.

Again, even assuming for a moment that a straight-shouldered horse can move a heavier weight than a horse with a sloping shoulder, even then this would not by any means entitle the straight-shouldered horse to be considered to be the most valuable animal of the two for agricultural purposes generally. A draught horse on a farm is rarely, if ever, required to pull the heaviest load he is capable of moving. What he is required to do, and what he is daily in the habit of doing, is to move a moderate load for as great a distance in a day as he can.

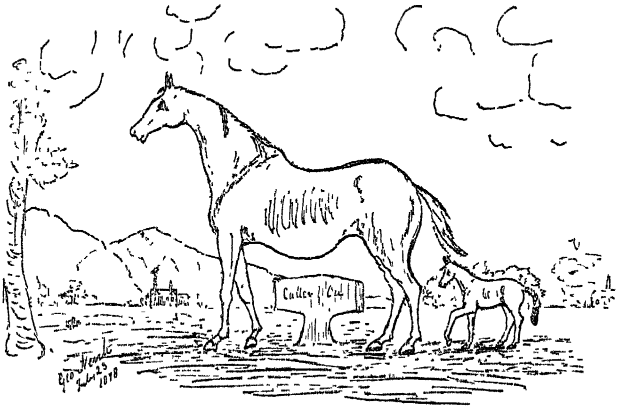
I may here say that, although ploughing and other work of preparing the ground does not consist of moving a load, but of overcoming the resistance of the ground to the implement used, yet still the task to the horse is so similar, that it may be considered, for the purpose of argument, as the same.

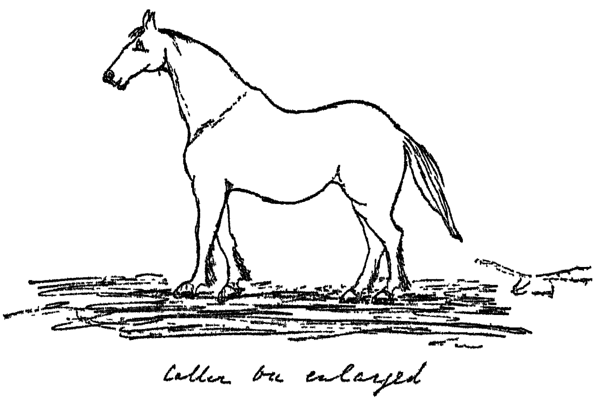
The work of a cart-horse, then, as a rule, consists in moving a moderately heavy load as far as he can in a day, and therefore the horse that can move the required load to the furthest distance in any given time is the most valuable.

The horse, however, that can take a load the furthest in a day, is the horse that can walk the greatest distance in any given time, that is, the horse that can walk the fastest; and a good-shouldered horse can always outwalk a straight-shouldered horse, and can consequently walk furthest in a day, and consequently do the most *work* in a day, and is therefore the most valuable animal of the two.

It is quite a mistake to suppose that one shape is better for one purpose, and another for another, and nothing has led to more disappointments than this error. Horses only differ in shape in being better or worse shaped than each other, and the same rules apply to every breed alike.

The merit of a cart-horse depends on exactly the same rules, and is governed by the same laws, as the merit of a racehorse, and what is a good shape in one is a good shape in the other, and *vice versâ*, and





symmetry, strength, and activity are valuable in both alike.

It may appear, at first sight, to a superficial observer, that there is no analogy or comparison between a heavy draught horse and a racehorse, but their shape is more alike than would at first be supposed.

I had accidentally a singular confirmation of this theory.

I had made a sketch of the celebrated racing mare Caller Ou, which I have the authority of her owner, Mr. I. Anson, of Malton, for saying is a very fairly correct representation of her. It was drawn when she had been for several years a brood mare, and was in what may be called a natural condition, and not, as is the case when horses are in training, an artificial condition.

Caller Ou won the St. Leger stakes in the shortest time but one in which it has been run during the last thirty years, and she afterwards won no less than thirty-five Queen's Plates.

This animal may, therefore, be taken as a fair specimen of the highest class of racehorse that the country can produce, and her shape, whatever it was, must have been, in a remarkable degree, adapted to the purpose for which she was required and used.

I wished to make a duplicate of this sketch, and in order to do so, cut it out with a pair of scissors, and then laid it on a sheet of paper and ran my

pencil round the outside of the figure I had cut out. On removing the pattern I was considerably surprised to find on the sheet of paper a pencil outline of what I considered to be a remarkably good shaped cart mare.

I have given a copy of the sketch of Caller Ou, and also of the outline obtained in the way I have described, in order that my readers may judge for themselves how far my theory is a correct one.

But even for simply throwing the greatest force into the collar—that is, for moving the heaviest load at the slowest possible pace—the horse with a sloping shoulder possesses a decided advantage over a horse with an upright shoulder.

The chief pressure on the horse's shoulder is a little below the centre, and if the point from which he was drawing (that is, the point to which the horse was attached) was as high as this point in his shoulder, there might be some foundation for saying that a horse with an upright shoulder could exert the most strength.

But in all cases the line of draught is from a point below the horse's shoulder, and in most cases it is *considerably* below.

The highest thing a cart-horse has to draw is an ordinary cart or waggon, and here the line of draught is from the axle of the cart to the horse's shoulder. In ploughing, harrowing, and dragging the line of draught is from a point very much lower than this,

and not very far above the level of the ground, perhaps about the height of the horse's knees or hocks.

Now, the horse can pull with the greatest ease to himself when the line of draught is at right angles to the inclination of his shoulder; and if you draw an imaginary line from the centre of the horse's shoulder to his hocks, and then draw another line at right angles to this line across the end of it nearest to his shoulder, you will find that a horse whose shoulder is of an inclination which corresponds the nearest to this second line will move a load from a point on a line a little below his hocks with the greatest ease to himself, and this will be a shoulder varying considerably from a perpendicular one.

There were formerly several well-defined breeds of cart-horses in England which in old days were kept tolerably distinct from each other, as far as we can learn; but since the introduction of railways and the consequent facility for sending horses about from one part of the country to another, these breeds have got so intermingled that their distinguishing characteristics have in many cases got nearly obliterated, and the number of horses which may correctly be termed of a pure breed has become correspondingly diminished.

The chief of the old breeds were four—the Clydesdale, the Cleveland Bay, the Suffolk Punch, and the old black Lincolnshire cart-horse, or rather dray-horse.

Of these four breeds the Suffolk Punch is at the present day the breed which has preserved its purity to the greatest degree, if, indeed, it is not the only breed that has done so at all.

The Suffolk cart-horse, however, of modern days is totally unlike in appearance to the description given in Youatt's book of those of the old Suffolk breed.

The modern Suffolk is well-proportioned, moves freely and gracefully, and has legs as clean and free from hair as a hunter.

They do not seem to answer so well away from the parts of England where they are in general use, and they are said to be subject more than other breeds to weak and shelly feet. The second of these defects may really exist, but in the case of the first objection to them, I should be of opinion that the reason why they do not do so well out of their own district is that in their own district the people who have to look after them are acquainted with the proper mode of treating them, and in other districts this is not the case.

The Suffolk horse is finer bred and consequently more nervous and delicate than the rougher breeds of cart-horses, and consequently requires more care and better treatment than the others.

This they probably get in their own country, and perhaps do not get in districts where other breeds of a rougher description are usually worked.

The Suffolk will not bear neglect, and will not bear knocking about as well as the ordinary rough-legged cart-horse, but where he is suitably treated he will prove a useful and valuable animal.

As regards the old Lincolnshire black dray-horse, there is still a breed of dray-horses of large size, but the distinctive colour is lost, that is to say, there are as many dray-horses of other colours as there are of black.

The Cleveland bay is as much of a coach-horse as it is of a cart-horse, and is not common. The Clydesdale, or a breed resembling it, is apparently the most numerous and general one now in use for agricultural purposes.

It has every appearance of a mixed or general breed, like the barn-door fowl; but there professes to be a pure breed in the Clydesdale district, and high prices have been given lately in that country for what are supposed to be pure descendants of the old original breed.

There is at present in use in Yorkshire a black breed of horses which does not come under any of the four denominations I have mentioned.

This breed possesses all the qualities desirable for working on farms. They have bright, intelligent eyes, with heads more like that of the thoroughbred horse, and clean legs free from hair, and soft glossy skins. They are quiet, nimble, and good workers, and as they are not mentioned as a breed in Youatt's

book, I should be inclined to think that they are descended from some old breed (perhaps similar to the Lincolnshire black breed), crossed with the thoroughbred horse.

Yorkshire is the only county I know where these sort of cart-horses are bred, and Yorkshire contains more thoroughbred blood than any other county in England.

CHAPTER VI.

ON CROSS-BREEDING.

A CROSS-BRED animal is an animal whose parents belong to two different breeds. A pure-bred animal is an animal whose parents belong to the same breed; but the term 'cross-bred' is often used by farmers in a wrong sense, and describing an animal as a cross-bred animal, often means to imply a reflection on its value. This, however, is quite a mistake, a cross-bred animal may be a very *well*-bred animal, and a pure-bred animal may be a very *badly*-bred animal.

If the first prize shorthorn bull at the Royal Show were mated with the first prize Hereford cow, the produce would be an essentially cross-bred animal, but would be about as well-bred as an animal could be. If, on the contrary, a man had a herd of pure shorthorns, and were to select, habitually, the worst specimens to breed from, in time, if he was lucky, he would be in possession of a herd of the worst-bred animals he could get, but they would still be a perfectly pure breed. A cross-bred animal, therefore, may be a well-bred animal or an ill-bred one, and a pure-bred animal may be a well-bred animal or an

ill-bred animal; their goodness depending on the merits of their parents and not on their breed.

A singular instance of the confusion of the terms 'well-bred' and 'cross-bred' is to be found in a letter addressed by Lord Althorp, who was one of the first great shorthorn breeders, to Mr. Pusey, who was then editing the earlier volumes of the 'Royal Agricultural Society's Journal.' Speaking of using a shorthorn bull, he lays it down as a maxim that 'the worse bred the cow is, the more the calf will resemble the father in appearance.' He ought to have said, and probably meant to say, that the more mixture of blood there was in the cow, that is, the more *cross-bred* she was, the more her calf would resemble the father if he were of a pure breed. This has been found to be the case for reasons which I will presently narrate.

The advantages of cross-breeding are two. One is, that a cross-bred animal is generally of a hardier constitution, and in general of a larger size than at least one of its parents, and often produces finer specimens than if the animals of the same breed were bred from.

The other advantage to be derived from breeding cross-bred animals is, when you have a moderate or inferior herd of cattle or sheep, but of a pure breed, it will often be found that even if you select a good bull or a good ram of the same breed, the progeny are little the better for it. When this is the case, if a flock or a herd were bred from a male animal of a

different breed, and the animals so bred were put to a good animal of the pure breed, the progeny of the cross-bred parents would be superior to the progeny of the original herd or flock when put to a good animal of the first breed.

That is to say, if you have a herd of inferior shorthorn cows, and wish to improve them, you may find great difficulty in doing so by the direct use of a first class shorthorn bull; but if you were to first use a good bull of another breed, and then when the cross-bred calves grew up, use a good shorthorn bull with the cross-bred cows, you will get a class of shorthorns superior to what you could ever have got from the original cows if you had kept to the same breed.

There are two reasons for this—first, the cross-bred cows will be finer, larger, and hardier animals than their mothers, and therefore will breed better animals; and secondly, their calves will, by the rule I have mentioned above, bear a greater resemblance to the good shorthorn bull than the calves of the bad shorthorn cows will.

A singular instance of success attending this method of proceeding in France is recorded in the 'Journal of the Royal Agricultural Society' for 1853, in a paper contributed by M. Malingié Nouel, entitled 'On a Method of Obtaining Immediate Fixity of Type in Forming a New Breed of Sheep.'

The paper is too long to quote entire in a work of

this description, but will well repay perusal. I will, however, quote some extracts from it which will give my readers an idea of the gist of the paper. I should say that the writer was at that time the director of the agricultural school of La Charmoise, and the article is, I see, on looking at the heading, translated from the French by Mr. Pusey. In it the writer says:—

'It is a mistake to improve the flock without changing the management. It is an equal mistake to improve the management without refining the breed. Both should advance together if profit be looked for.

'Still, it has been found that our old breeds may be crossed with English blood not only without profit, but with heavy loss. To clear up this matter, it will be worth while to enter into particulars, as the question is interesting, and in general not well understood.

'When an English ram, of whatever breed, is put to a French ewe, the lambs present the following results. Most of them resemble the mother more than the father. Some show no trace of the father; a *very* few represent equally the features of both. Encouraged by the beauty of these few, one preserves carefully the ewe lambs among them, and when they are old enough put them to an English ram. The product of the second cross, having 75 per cent. of English blood, are generally more like the father

than the mother, resembling him in shape and feature. The fleece also has an English character. The lambs thrive, wear a beautiful appearance, and complete the joy of the breeder. He thinks he has achieved a new cross-breed, insuring great improvement, and requiring thenceforth only careful selection to perpetuate among themselves the qualities which he has in view. But he has reckoned without his host, for no sooner are the lambs weaned than their strength, their beauty, and their vigour begin to decay as the heat of summer increases. Instead of growing they seem to dwindle . . . and remain inferior even to our native sheep, which at least have health and hardiness in their favour.

'The experiment has sometimes been tried with English rams in a third generation, and the symptoms above described have arisen even more strongly in proportion to the stronger admixture of English blood . . . and it is remarkable that the same results arise equally with each kind of English ram that has been used, Leicester, New Kent, or Southdown.'

A little further on he says: 'The purer the race of the ancestor, the more strongly do its characteristics imprint themselves on the new offspring. . . . Clearly, then, the influence of the ram upon the offspring will be stronger, the purer and more ancient, in the first place, his own race may be, and the less resistance is offered by the ewe through the possession of those qualities. We have seen above that an opposite state

of things had obtained in France in all these trials, since purity and antiquity of blood exist much more strongly in the French breeds than in the English, which have been more recently formed.

'It appeared, then, that in order to untie the Gordian knot whose threads I have traced, inasmuch as one could not increase the purity and antiquity of the blood of the rams, one must diminish the purity and antiquity of the blood of the ewes. . . . We find in France many border countries lying between distinct breeds, in which districts it is easy to find flocks participating in the two neighbouring races. . . . Among these, then, I chose such animals as seemed least defective. . . . These I united with animals of another mixed breed, picking out the best I could find. From this mixture was obtained an offspring combining four races, without decided character, without fixity, with little intrinsic merit, certainly, but possessing the advantage of being used to our climate and management, and bringing to bear on the new breed an influence almost annihilated by the multiplicity of its component elements.

'Now what happens when one puts such mixed blood ewes to a pure new Kent ram? One obtains a breed containing fifty-hundredths of the purest and most ancient English blood, with twelve and a half hundredths of four different French races, which are individually lost in the preponderance of English blood.

'In this case all the lambs produced strikingly resembled each other, and even Englishmen took them for animals of their own country. But what was still more decisive, when these young ewes and rams were put together, they produced lambs closely resembling themselves without any marked return to the features of the old French races. . . . Such is the origin of La Charmoise breed of sheep.'

PART III

CHAPTER I.

ON FARM BUILDINGS.

THE farmstead in the case of ordinary occupations of 200 to 300 acres should be built in the form of a square, having buildings on three sides of the square and a wall on the fourth side.

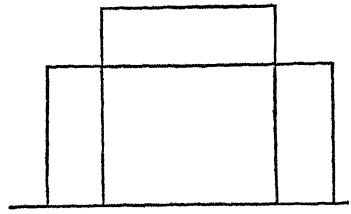
The buildings should be on the west, north, and east sides, and a wall on the south side.

This block should contain all the buildings required for the farm, with the exception of the waggon and implement shed, which should form a separate block, and should have a loose box at one end of it to separate any animals from the rest when it is desirable to do so.

The buildings round the three sides of the square should not be continuous, but each side should form a separate block, having its own roof uniform throughout the block, and the blocks should be placed together in the same manner as if you formed a square of three bricks touching only at one edge, thus :—

The block on the west side should be about ninety-six feet long, eighteen feet broad, and seventeen feet high.

The block on the north side should be a hundred feet long, and seven feet high, and six feet deep.



The block on the east side should be ninety-six feet long, thirteen feet wide, and seven feet high.

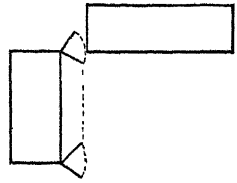
These measurements are inside of the outer walls of the block, and the height is measured up to the eaves.

The waggon and implement shed should be about a hundred feet long, and twenty feet wide, and eight feet high.

The first, or west block should be divided at right angles to its length into four compartments as follows. The one at the south end should be fourteen feet of the length, the next thirty feet, the next thirty-six feet, and the last, or northern compartment, fourteen feet, or thereabouts, the partitions being taken out of these measurements, or the whole block being slightly increased in length to allow room for the partitions.

There should be a causeway of asphalte five feet wide in front of this block, running the entire length of the block, with a door 4 ft. 6 in. wide at each end.

The causeway should run on the inside of the square formed by the buildings, and the west end of the south block should be placed at a sufficient distance from the corner of the west block as will allow of the causeway and door to come between, thus :—



The block at the east side of the square should be divided as follows, at right angles to its length, beginning at the south end :

The first division should be nine feet, the second thirteen feet, the third twenty-four feet, and the remainder of the block divided into five equal spaces.

There should be a similar causeway 4 ft. 6 in. wide running the whole length of the block on the east side, with a door four feet wide at each end.

The south side of the square should consist of a wall 6 ft. 6 in. high, with a door at each end opening on to the causeways, as I have described, and a pair of folding doors wide enough to allow a waggon-load of straw to pass through in the middle. The doors should be nearly the same height as the wall.

CHAPTER II.

The first partition in the block on the west side of the square, that is, the partition at the south end of the block, should be divided in half, the reverse way to the other partitions.

One half will form the tool-house and boiling-house, which must open at the south end of the building, and the other the gear-house, which must open inside the fold-yard.

The next partition will be the stables. This should be arranged as follows:—

There should be a door in the centre of the wall along the causeway, and another door in the wall opposite the first door, and a gangway of brick eight feet wide from one door to the other.

The spaces on each side should be divided into three stalls, so that the horses stand with their tails towards the gangway.

The next partition should be the barn, having a plaster floor and doors at each side. The dimensions of all the doors in the buildings will be given separately further on.

The last partition of the west block should be the out-house, in which to cut fodder for the horses. It should be divided into two storeys, with a wooden floor in the upper one, and a square hole in this floor. The cutting-machine should be on this floor, and placed so that the stuff when cut falls through the hole to the chamber below. The horse-power should be outside, in the angle formed by the west and north blocks.

There should be a door in the east side of the low chamber to get the cut stuff out, and a door on the west side of the upper chamber to put the straw or hay in at to cut.

The whole length of the north block should be an open shed, with the opening to the south, and divided into two or more compartments by railings to suit the convenience of the tenants.

In the angle formed by the north and east blocks there should be a tank to take the rain-water from the roofs, which should be spouted.

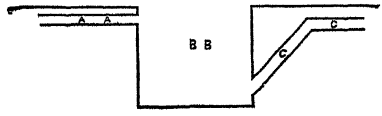
The tank should be built of brick, and cemented or lined with metal, and the bottom raised three or four feet above the level of the floor of the buildings.

There should be a stone trough in the centre of the farmyard, raised a foot or so above the ground by brick pillars, and this trough should be supplied by a pipe and tap from the tank.

There should be a grating round the trough between the trough and the ground, and a drain with a

grating over it under the trough to take the wet away from the fold-yard. This drain should go into a manure tank at some convenient place outside the farm-buildings.

The manure tank should be shaped thus—



A A is the drain from the yard running in near the top of the manure tank.

B B is the manure tank.

C C is a drain conveying the liquid away from the manure tank.

The upper part of C C should be slightly lower than A A.

It will be seen that if B B is empty, water would run in till it rose to the level of C C, and after that, as water ran in at A A, an equivalent quantity would run out at C C.

The object of making the overflow pipe C C commence at the bottom of the manure tank is this :—

Earth of several kinds filters sewage, and if the tank B B were filled with loose earth, the sewage which came in at A A would be filtered in its passage through the earth, and would run out at C C more or less clear water.

The earth in B B should be taken away periodically, and fresh earth put in.

By this means any objectionable smell from the sewage would be avoided, and all the valuable part of the sewage would be retained in the soil in the tank, which should be spread on the land.

The tank should be about eight feet each way, and not more than six feet deep, and should be made in the same manner as a water tank, viz., of bricks mortared together, and then lined with cement.

The block on the north side should be an open shed the whole length of the block, and should have a solid brick manger running the entire length of the shed, 2 ft. 6 in. high, 2 ft. 2 in. wide, and 9 in. deep. The shed should be 7 ft. high at the side where the manger is, and 12 in. fall in the ground from the back to the pillars, which may be of wood or iron on brick pedestals 2 ft. high.

The block on the east side of the square should be divided as follows, beginning at the south end.

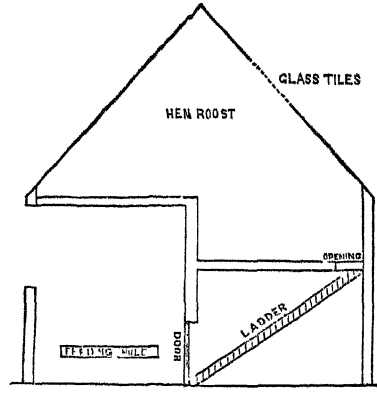
The first division should be used as a boiling or meal-house, in which to keep and prepare the food for the pigs or any other of the animals which require steamed food.

There should be a copper or some other suitable apparatus for cooking potatoes and meat in this compartment, and the door should open into the fold-yard.

The second division should form the pigsties, and should be divided into four, two yards and two sties; the yards should be to the inside of the yard, and the

sties should have a hen-house over them; the roof should be uniform with the rest of the block, but the upper part of the wall next the gangway should be left unbuilt from the height of four feet upwards.

The yards should have two doors set upon steps of brick nine inches high; this will prevent the bottom of the door from being spoiled by liquid in the pig-yard.



There should be a feeding-trough, and opening on the inside of the fold-yard for each pig-yard.

The third partition should be the cow-house, on the same plan as the cart-horse stable; but the cows should stand with their heads towards each other, and there should be a causeway between the two rows of cows, with a wall on each side; and there should be a door at each end of the causeway, one opening into the stack-yard and the other into the fold-yard.

The cows should stand in stalls, with a causeway behind each row of cows.

The remainder of this block should consist of five loose boxes, not less than about nine feet each.

Two of these should have mangers running the whole length of the side of the box, and the other three should have mangers across the end, opposite the doors.

The mangers that are on the *sides* of the boxes should be rather lower than those at the ends, as they will be for calves to eat out of.

There should be a door about three feet square, and three or four feet from the ground, in one of the centre boxes, in the wall opposite to the door, in order that this box may be used as a root-house, or to cut turnips and break cake in if desired.

The Waggon-Shed.

The waggon-shed should be a separate block to the south of the farm buildings on the west side, and should face east. It should be divided into three bays, one of which should be ten feet, to admit a drill or reaping-machine, and the others 8 ft. 6 in. each in the clear, or as much more as the space will allow. At one end a ten-foot bay should be walled off and divided across the middle so as to form a gig-house to the front of the shed, and a loose box opening to the back of the shed.

This box will be useful to separate any animal from the rest when occasion requires.

The shed should be ninety-six feet long, twenty feet wide, and eight feet high at the eaves, and should be placed so that there is plenty of room for a waggon laden with straw to pass between the shed and the other buildings.

The Doors.

It is a saving both of time and confusion to have all the doors made in sizes, that is, to have as many doors of one height and width as the requirements of the building will allow of.

It will be found that most or all of the doors will answer to be one of three or four different sizes.

The largest size will be the barn-doors and the folding-doors of the fold-yard.

The doors into the fold-yard should be about five feet wide, and six and a half feet high, so as to give an opening of ten feet.

The barn-door on the side next the fold-yard should be about five feet wide and seven feet high, and should be cut into two parts crosswise, like the stable-door.

The doors on the outside of the barn, that is, on the west side of it, should be folding-doors about 8 ft. 6 in. wide each, and about 7 ft. 6 in. high.

The next largest sizes should be the stable-doors and the doors at each end of the gangway which

run along the block in which the stable and barn are.

These should be wide enough to let a full sized cart-horse through with his gears on, and that will be not less than 4 ft. 6 in. wide.

The next size should be for the doors to the cow-house, loose boxes, and the ends of the gangway in front of them.

These should be 3 ft. 9 in. wide, that is, big enough to admit a large cow or a cart-horse without gearing.

The fourth size should be for the pigsties, granaries, and tool- or boiling-house.

These should be three feet wide.

All the doors in the stable, cow-houses, and loose boxes should be cut in two crosswise, about three-fifths of their height from the ground, so that the upper part can be set open while the lower is shut. There is a great advantage in this, as the box or other building can be entirely or partially closed, as may be most desirable. These double doors have all the advantages of a single one, and some more advantages besides.

There should be a space in all the boxes and the stables of from nine inches to a foot between the top of the door and the top of the door-frame, and this should be the only opening, with the exception of a brick or two left out in the opposite wall, near the top, and will serve both for light and air. It will be found

to keep the box at an equal temperature, and quite warm enough and light enough, and the box will be free from a current of air blowing across the animals' backs, and when the door is opened it will not cause any draught.

All the doors should be fastened with wooden fasteners of some kind, and there should be nothing sticking out from either the door or the door-frame which can cut or hurt an animal going in or out. This is a very important point, and will save the chance of a serious accident.

A simple and efficient mode of fastening them is to have a wooden bolt in each door to slide into a hole mortised in the door-frame. The advantage of this plan is, that when the door is open the bolt is drawn back, and there is nothing sticking out to catch the animal.

Remarks.

It may not appear to anyone unacquainted with practical farming, or taking a superficial glance at them, that there is any particular merit possessed by the plan on which I have arranged the buildings over any other.

But there is a reason why nearly every part of the building should occupy the particular position which it does in the plan, and also there are advantages in the mode of arranging the blocks.

To begin with the blocks taken as a whole building.

In England the strongest winds are from the west, and therefore the highest block of buildings should be on the west side of the square.

Now the barn ought to be considerably higher than any other part of the building, which is only one storey high; therefore I begin by placing the barn on the west side of the block of buildings.

The best situation for a granary is over the cart-horse stable, for this reason, which would not at first strike every one. Many things are kept in a granary in winter which it is desirable to protect from frost, and the stable underneath being the part of the building most constantly occupied in winter, is kept at the highest temperature.

It is also desirable that the barn should have a door into the granary, as corn is dressed in the barn and stored in the granary; and therefore the granary is placed next to the barn in the plan, and the cart-horse stable is placed under it.

It is also desirable that the stable should be easy of access for the men who look after the horses, and therefore it is placed near the entrance of the fold-yard.

It is necessary that the gear-house should adjoin the stable, and it is desirable that the tool-house should not open into the fold-yard, and by the arrangement of the plan both these objects are effected.

The cut-house requiring to be two storeys high, it has to be part of the high block, and completes the block.

The horse-power outside this block would be considerably better by having a roof over it, for two reasons :—

First, that it would keep the machinery from rusting; and, secondly, as wet afternoons are often selected for cutting a supply, because the horses cannot then do anything else, the horses and harness, and the man who drives them, would be kept dry.

The roof could either be a circular one of an extinguisher shape, supported on pillars, or could be a continuation of the block which forms the open shed; this would depend partly on the size of the horse-power attached to the cutter and partly on its exact position. If the simple continuing of the open shed is sufficient to cover the horses at work, it will be the best mode of construction, and will only require a pillar at the outside corner, and perhaps two more.

The open shed should in all cases face the south, so that as much sun as possible may get into it, and the side opposite to it should be kept low, so as to keep as little sun off the yard as possible. The position, therefore, of the open shed is determined, and, as even a high wall is considerably lower than a roofed building, there is good reason for having no building on the south side of the square.

The wall should be high in order to keep the wind from the beasts in the yard, and there should invariably be doors to enter the yard by and not gates.

There is a very great difference between the temperature of a yard with a high wall and doors, and one with a low wall and a gate; and as, next to food, warmth and shelter is one of the most important requisites for feeding stock, it is desirable to have every place in which stock is kept as warm and as equable in temperature as it can be made.

As regards the arrangement of the fourth or east side of the block, the pigsties, boiling-house, and cow-house are most visited in the course of the day, and should be nearest the house.

The advantage of having a number of loose boxes in a farmstead is very great; for while a cow-house can only be used as a cow-house, and a pigsty will not do for anything but pigs, a loose box, on the contrary, can be used indiscriminately either for horses, cows, calves, pigs, or as a root-house to store turnips and hold a cake breaker and turnip cutter.

One of the boxes, the one nearest the centre of the block, should have a square opening about four feet from the ground, and about three feet square, with a wooden door opening outwards. The object of this is to put hay or roots through the opening instead of having to carry them round.

The boxes should, some of them, as I before stated, have the rack and manger at the end, and some at the side. Those with mangers at the end will be most convenient for a mare and foal, or a cow and calf; and those with the rack and manger at the side will

be most suitable for young stock, such as calves, yearlings, beasts, and foals, for this reason, that a greater number can get to the manger at once. These boxes, therefore, which are constructed for young stock, ought to have the mangers and racks placed lower than those with the mangers at the ends.

The Crew-Yard.

The crew- or fold-yard is the place where all the young and growing stock of cattle and horses are kept during the winter, and plays, therefore, an important part in the economy of the farm; it is also the place where the manure, which is the basis of all crops, is manufactured.

The two requisites for fulfilling these two parts is, first, that it should be as dry under foot as it can be got; this is an advantage both in the manufacture of the manure and the feeding of the beasts.

The second requisite is, that it should be as warm and free from draught as possible.

As regards the second requisite, which I will take first, nothing promotes draught so much as open passages, alleys, and corners and irregularities of the heights and fronts of the buildings round it; and nothing promotes an equal, and therefore favourable temperature as the absence of all this.

It should also be as free as possible from any corner or places where the stronger beasts can hurt

the weaker ones without the weaker ones being able to get away from them.

In the arrangement of buildings I have described there are few places where the wind can get round and form an eddy as is possible, and the yard is constructed so as to admit as much sun and as little wind as can be admitted.

The next requisite, that the fold-yard should be as dry as possible, is not sufficiently attended to as a rule.

This end is attained by two means: first, having as good and even and dry a floor as can be provided; and secondly, by making arrangements to drain all the liquid away from the bottom of the yard as quickly as possible into some receptacle *out*side the yard.

It is not the custom to pave the bottom of the fold-yard; in many cases it would be found expensive, but where circumstances will admit of its being paved cheaply, or where the expense is not a matter of sufficient importance to deter anyone from doing it, would, in my opinion, amply compensate the occupier in the increased comfort to his men and his stock, and the improvement it would make in the manure.

On sanitary grounds also it would be far preferable to the present system.

As crew-yards are usually constructed, the bottom of the yard, for the greater part of the winter, is nearly as bad as a swamp, with several inches of the

strongest liquid manure at the bottom. This is always soaking into the ground, and the ground consequently becomes polluted to a considerable extent; and as the farmhouse is generally adjoining the farmyard, and the well for the water which is drunk by the farmer's family is contiguous to the house and not far from the yard, it follows that the impure water from the yard finds its way to the well, and poisons the water, making it unfit to drink.

This, I need not say, will be more the case in sandy and light soils than in clay, and more in old farmsteads than in more recent ones; but it is quite of sufficient importance in many places to make it worth while to make some provision to prevent it. A paved yard would be free from these disadvantages.

If the yard is paved, or, indeed, in any case, there should be a grating in the middle of the yard under the drinking trough, and a drain to convey the liquid manure to the manure-tank.

In the plan I have placed the south wall at the end of the buildings, but the size of the yard may with advantage be diminished by leaving the gear-house, boiling-house, and pigsties outside the wall, as shown in the smaller plan.

The yard may be still further contracted if desired, by springing the shed at the north side from the side of the cut-house instead of the end, and making a similar alteration at the other end of the shed; in which case the two gangways will go to the back of

the shed, and the door of the cut-house and the door of one loose box will come under the shed instead of outside of it. See smaller plan.

The Manure-Tank.

The manure-tank should be a brick tank sunk in the ground and lined with cement, and in all respects similar to a water-tank underground.

It should be placed in some spot not too far from the yard and easy of access, and not where there is likely to be any traffic of carts and waggons over the spots, and should be covered with oak slabs or with flag-stones, and made impervious to the air to prevent any smell arising from it, and it should also be at some distance from the house.

It should be big enough for a man to use a spade or shovel in easily, so as to have no difficulty in cleaning it out, and should not be above five feet and a half deep, or the man who cleans it out will have some difficulty in throwing up the soil in it when he gets to the bottom.

There should be a drain from the grating in the middle of the crew-yard to the cesspool, or manure-tank as I will call it, and this drain should be kept as near the surface as possible, so long as it will convey the liquid manure from the yard.

At the bottom of the tank, or a few inches above the bottom, and at the opposite side of the tank to

that at which the first drain enters, there should be another drain made of sanitary pipes cemented together, and running up in a slanting direction to nearly the same height as the drain from the cow-yard, but a little lower, and this drain should then be continued to the nearest outfall.

This tank should be filled with earth up to the level of the drain from the yard, and the earth should be taken out at short intervals during the winter and fresh earth put in.

Any sort of earth that is not strong clay or very sharp sand will do, but black or peat earth will answer as well as any.

It will be seen from the description I have given, that the liquid manure will enter the tank at the top and filter through the earth and leave the tank at the bottom, and then rise up the slanting pipe and run down the lower drain to the outfall.

The liquid will be nearly, if not quite filtered in its passage through the earth, and will run out clear water.

The earth should be changed as soon as it is saturated with manure.

The object of this arrangement is as follows:—

If there is no liquid manure-tank, and the liquid is simply drained away, as it often is, to the nearest ditch, a great deal of valuable fertilising agent will be wasted, and in addition to that all the land round will be poisoned with the manure which leaks into it,

and the water on its passage to the wells will be affected.

If, on the other hand, the liquid manure is conveyed to a tank, and then pumped out, and the land irrigated with it, a very costly operation is made necessary, and one which an ordinary tenant farmer cannot afford to put in practice, as it means in effect that all the rain which falls on the surface of the crew-yard, which, it must be remembered, measures some thousands of square feet, must be pumped up and carted on to the fields, which entails a great expense with no corresponding advantage; and if it is done in summer, takes men and horses from their work on the land when it is most required; and if done in winter, is taking a large quatity of water on to the land at a time when it generally gets plenty of it in the natural course of events.

By adopting the plan I have described, the valuable parts of the liquid are practically retained, and the cost of conveying it on to the land reduced to the smallest possible dimensions.

The Barn.

The barn should be made with a plaster or cement floor, and should have doors on each side of it. These should not be exactly in the middle, but should divide the barn, as it were, into two unequal portions, the shortest end being nearest to the stable.

In old-fashioned barns the doors were generally made large enough to admit a waggon laden with corn or straw, and it was commonly the practice to stack as much corn in the barn as the barn would hold. But since the introduction of steam threshing machines this has not been such a desideratum, and there is no occasion to have the doors made so large.

It is advisable, however, to have the outer doors, that is, the doors away from the fold-yard, made high and wide enough to back a cart partially laden into the barn.

They should be folding doors to open outwards, with a circular top, and about seven or eight feet high, and seven feet, or 7 ft. 6 in., wide.

The exact height and width are not material.

The inner door, or the door next to the fold-yard, should be smaller, about five feet wide, and 6 ft. 6 in. or seven feet high, and should also open outwards. It should be in two halves, an upper and lower one, the upper part being the smallest; but, unlike the doors to the boxes, it should fit close to the frame all round, and not have an interval between the top of the door and the frame.

There should be a door into the granary over the stable opening out of the barn, but it should be reached by a movable step-ladder, which can be put away on one side of the barn when it is not required. Both the doors to the barn should, of course, be made to lock.

There is another granary over the tool-house and gear-house, and the floor of this should be of boards, and should be entered by a step-ladder and door over the tool-house door.

The granary over the stable must have a plaster floor, as a wood floor would not be sufficiently impervious to the steam from the horses.

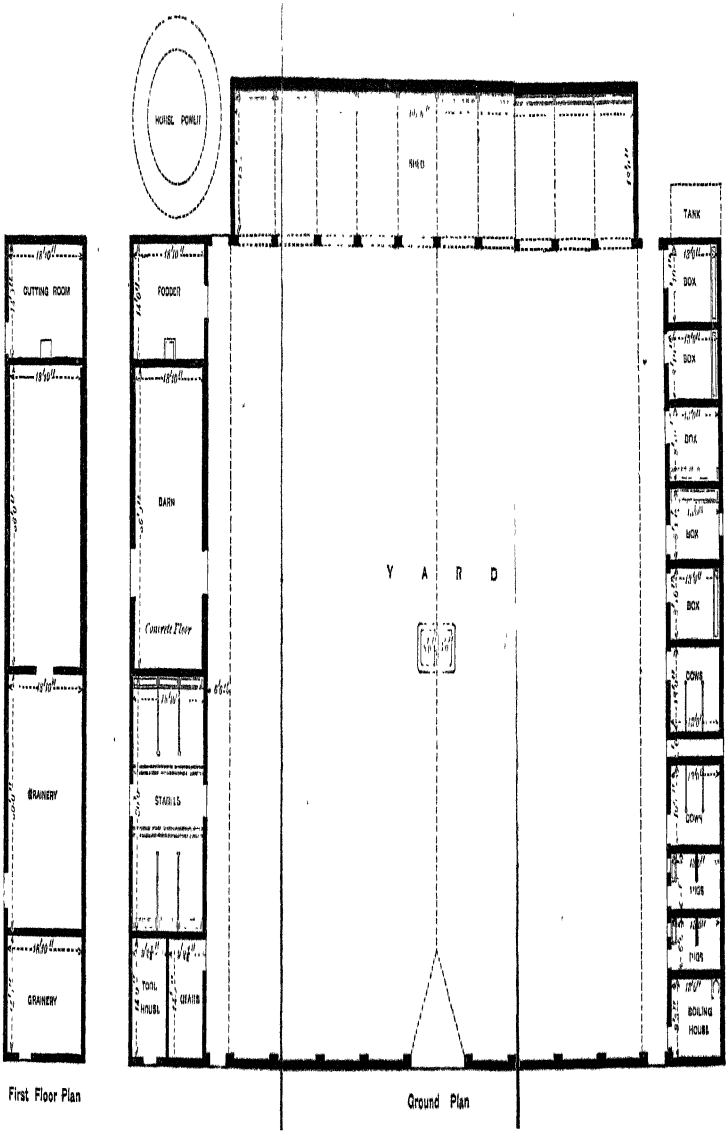
Drainage.

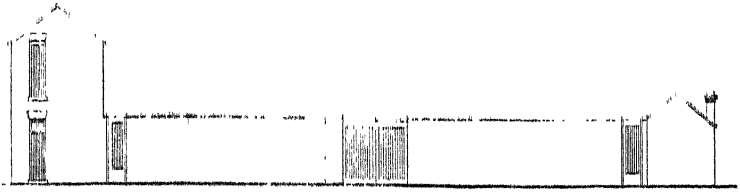
Sufficient provision is not usually made in farm buildings to take away the wet arising from the rainfalls in and about the buildings.

Many of the buildings are often left unspouted, and all the rain that falls on the roofs remains on the ground round the buildings, making it sloppy and unpleasant whenever there is any fall of rain longer than a shower.

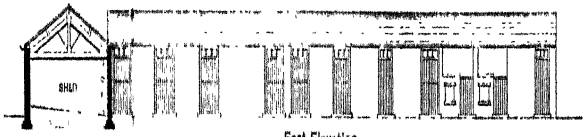
The buildings should, in all cases, be completely spouted on both sides of the roof, and the water conveyed to a tank, or, in the case of small blocks of buildings, a hogshead or large barrel will answer the purpose.

This will do away with the greater part of the evil, but it will be found that even if the buildings are spouted, there is still always a great deal of wet all round the walls on the ground immediately adjoining, that is, there will be more wet there than anywhere else.

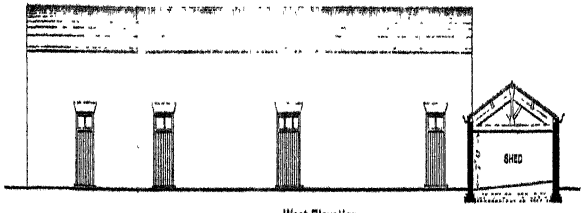

HORSE POWER
SHED
TANK
CUTTING ROOM
FODDER
BOX
BOX
BOX
BOX
BOX
BARN
Concrete Floor
Y A R D
COWS
GRANERY
STABLES
COWS
PIGS
PIGS
GRANERY
TOOL HOUSE
GRAIN
BOILING HOUSE
First Floor Plan
Ground Plan



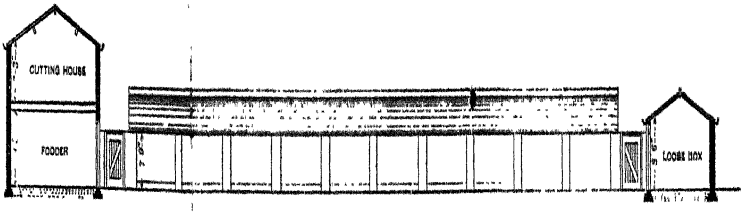
South Elevation



East Elevation



West Elevation



North Elevation

The reason of this is not, at first sight, obvious, but I take it to be this:—

When the rain falls perfectly perpendicular, and the buildings are spouted, there will be no more rain fall on the ground in the immediate vicinity of the walls of the farm buildings than what falls anywhere else, but the rain rarely comes down perpendicularly, but generally in a slanting direction.

When this is the case, a good deal of rain beats against the sides of the buildings, and then runs down the wall to the ground, so that there is more wet close to the wall than anywhere else whenever the rain beats *on* to the wall.

There are two ways of remedying this, and I should prefer to use them both. The first, which should in all cases be done where new buildings are getting built, is as follows:—

When the ground is dry, and a trench made for the foundations of the walls, there should be a drain laid made of the ordinary pipe-draining tiles and collars, on the same level as the first course of bricks laid, this should be connected with an outfall underdrain to carry the water away.

This will prevent the land in the immediate vicinity of the buildings from becoming saturated with wet; but where the soil is of a strong clayey nature, or where the buildings are intended for a home farm, and a little more expense is not of much consequence, it would be found a great improvement

to run a gutter two or three inches deep, and about as wide, all along the surface of the ground against the walls. The rain which runs down the walls will then go straight away down the gutters without entering the ground at all.

Attention to small matters like these, which appear trivial in themselves, will make a great difference to the welfare of the stock contained in the buildings, and the comfort of the people who look after them.

The Plans.

I have given a ground plan of a set of farm buildings arranged in the manner I have described and of the shape and dimensions given in the book. The plans have been drawn for me by Mr. David Petch, of Scarborough.

The advantages of the arrangement I have given are as follows:—

In the first place, they are on an intelligible system, that is, there is a reason for each part of them being where it is and like what it is.

In many cases, from the nature of the ground or other causes, it will not be practicable perhaps to adhere strictly to the details given in the plan; and when this is the case, from the system I have adopted of making each side of the building a separate block, the plan is easier to modify or alter, or to only build part of, than if it were drawn on a continuous line of building. As the roofing and work is quite straight,

it also is the cheapest form of construction that could be adopted.

It is also constructed so that any part may be left out without altering or spoiling the method of construction, and it can also easily be expanded to suit a larger farm to almost any amount.

Thus in the case of more accommodation being required, for instance, the open beast-shed can be made as much longer than the plan as is wished, without altering any other part of the plan, by simply placing the block on the east side and that on the west side further from each other.

If greater stable accommodation be required, it can be obtained by inserting another stable, similar to the one drawn, between the present stable and the barn.

The same may be done with the cow-houses, pigsties, and loose boxes.

If the east and west blocks were considerably lengthened, a second shed can be introduced across the middle of the yard, facing south, the same as the present one, and with the same openings through it that are given in the wall at the south side of the square.

If, on the other hand, a set of buildings for a smaller occupation and at less cost is desired to be erected, the size is just as easily reduced as it is expanded. The first plan I have given is suitable for and sufficient for a farm of three hundred acres, one hundred of which is grass.

We will suppose that a plan is desired for an occupation, say, of sixty or seventy acres of plough and thirty or forty of grass. In this case there being less land to plough, there will be a smaller number of cart-horses required to work it.

The first thing, therefore, is to reduce the stable accommodation. This is done by taking away the standings on one side of the gangway and leaving the rest of the stable as planned.

In a small occupation, with only three horses, it is not necessary to have a horse-power cutting-machine, as the food can be cut in the barn or elsewhere by a hand with an ordinary hand-cutting machine.

The part of the plan, therefore, which comprises the cut-house can be therefore dispensed with. This will shorten the block at the west side of the square considerably, and the shed for beasts can be shortened to correspond.

The block at the east side can be shortened by omitting the cow-house and some of the loose boxes, or by omitting half of the cow-house and some of the loose boxes.

The cow-house can be better spared on this side than anything, because in a small holding the number of cows milked can be kept in loose boxes—two in each box; and then in summer, when the cows are milked out in the fields and sleep out altogether, the boxes can be used for calves or anything else required.

I may here say that it is desirable to have the plan kept as much as possible in the form of a square, whatever the size of the buildings, and also that there should be nothing but the open beast-shed on the north side of them and the wall on the south side of them.

I have given a second plan, similar to the first in arrangement, but reduced in size as I have described, to show how the buildings can be modified or altered.

Any part of the buildings, again, can be built without the rest, where it is desired to add on to old buildings or increase already existing accommodation.

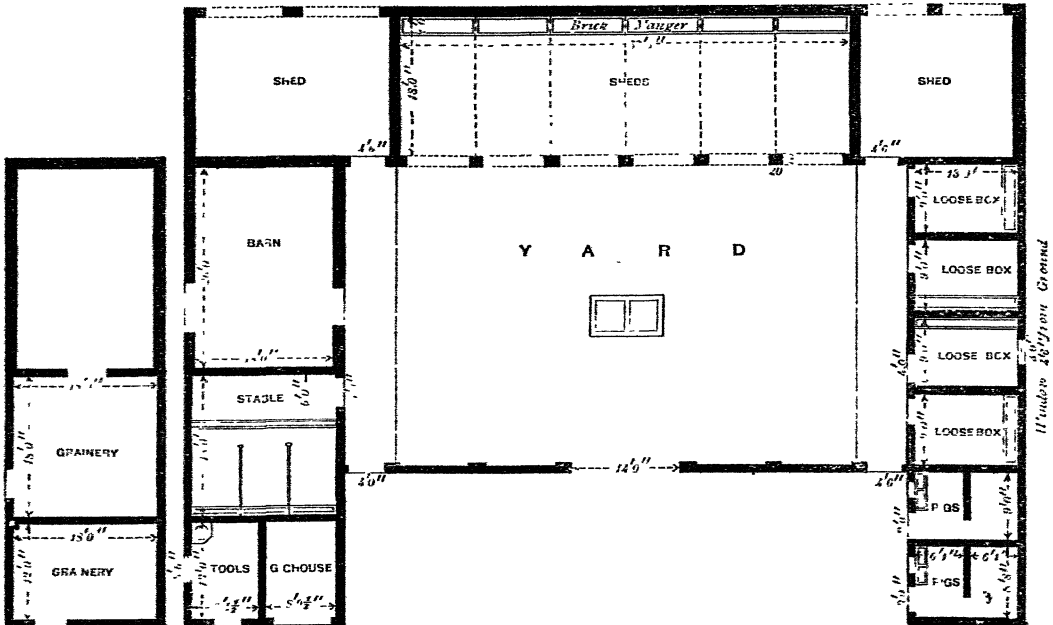
In this case the shape and size of each part can be built as drawn, but the position of it will have to depend on circumstances.

I have, in order to render it more intelligible to my readers, furnished a second plan, drawn by Mr. Petch, of a set of buildings on a small scale.

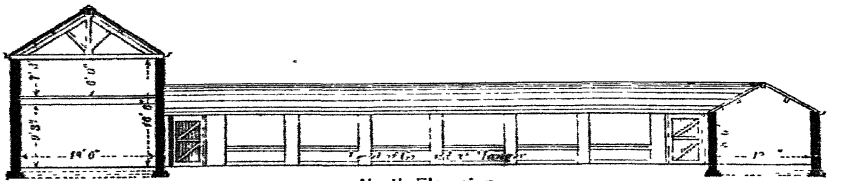
In this plan I have, as will be seen, placed the south wall somewhat nearer to the shed on the north side of the block, so as to leave the ends of the east and west blocks outside the yard.

The advantage of this is that in a small occupation straw is not so plentiful as in a larger one; and by putting the wall where I have done, the size of the open yard is diminished and the proportionally smaller quantity of straw or other bedding required to cover it.

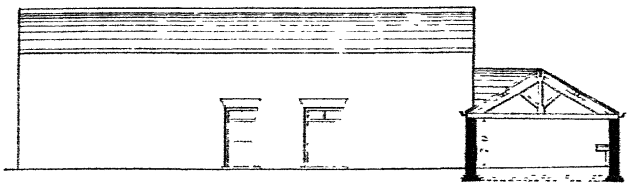
The buildings left outside are, as will be seen, the



Ground Floor Plan



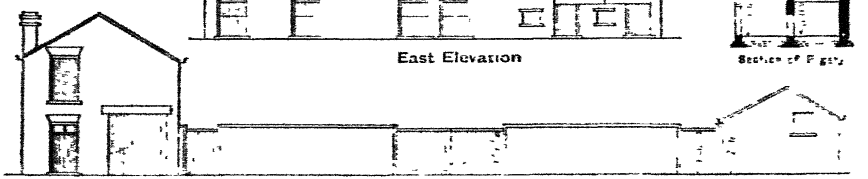
North Elevation



West Elevation

East Elevation

Section of F gate



South Elevation

tool-house, gear-house—which in this plan I have made into a gig-house—and the pigsties.

Of these, the tool-house would open outside the yard under any circumstances. The pigsties, being repeatedly supplied from the house with swill during the day, will be found to be as conveniently situated outside the yard as inside.

In this plan the harness can be hung in the stable or in the gig-house, whichever is thought best.

It will also be seen that a pillar is placed in the plan in a line with the north wall of the open shed.

The object of this is as follows:—

In a larger farm I have recommended that the implement shed should be built separate from the other buildings, and with a piece taken off one end to be made into a loose box at the back, with a yard and a gig or dog-cart house in the front.

In a small farm, however, such as the smaller block of buildings is intended for, there is less space required for implements, and there is not the same reason for having a separate shed built for them.

Now by simply continuing the roof of the open shed at the north side of the square to the outside walls of the east and west blocks, instead of terminating it at the inside walls, and by supporting this roof by one or more pillars on the two sides where there is no walling, we obtain two open sheds, opening away from the buildings, which can be used for carts and other implements, and will be found sufficient.

This way of obtaining shed room will have the advantage of costing considerably less than if a separate shed were built.

The Granaries.

The granaries attached to a set of farm buildings are of no less importance than the other parts of the building. The farmer will require at times to store corn and wool, and also apples, and onions, and a variety of other things in them. The principal granary should be over the stable, and open into the barn; and this will be found to be the best place in which to keep anything likely to be affected by frost, as the stable below will be occupied during the whole of the winter, and the heat of the horses' bodies will help to keep the granary partially warmed, and prevent the things kept in it from being injured by frost.

This granary should be reached by a movable step-ladder, kept in the barn.

There should be another granary over the boiling-house and gear-house, and this should have a door opening at the south end of the block, either over the boiling-house door or on one side of it.

This granary can be reached either by a movable step-ladder or by a fixed step-ladder, or other flight of steps at the south end; but if the steps up to it are a fixture, they should in all cases be guarded with a hand-rail, otherwise anyone might step backwards and fall off them.

If a third granary is thought desirable, it can be obtained by carrying the end of the cart-shed, which is divided into a loose box and gig-house, another storey higher.

The Farmhouse.

It is not my intention in this work to give an elaborate and detailed description of a farmhouse suitable for the buildings contained in this book. The theory of building houses is much more generally understood, and the knowledge requisite for doing so is much more widely disseminated, than is the case with the buildings belonging to and required for farms of various sizes.

In addition to which, the number of houses suitable for the purpose which are built in a year exceed immensely the number of sets of buildings, and it is consequently proportionately so much easier to find a house of the pattern, or nearly so, that is desired.

I will, however, take the opportunity of mentioning one or two points which it would be well for people who are contemplating building farmhouses, either to old buildings or with new ones, to bear in mind.

First, then, as to the position which the house should occupy with regard to the buildings.

This, in many cases, is settled beforehand from the nature of the ground and the position of the roads, &c.

Where, however, it is a matter in which the owner of the farm can please himself, the most convenient situation for the house to occupy will be to the south of the farm buildings, with the front facing south and away from the buildings, and the back facing north and overlooking the fold-yard.

The advantages of this position are as follows: —

First, the block of buildings being on the north side of the house will protect the house from the north winds.

Secondly, the back-door will be in the most convenient place for going to and from the yard to feed the pigs or calves, or to milk.

Third, the windows of that side of the house will overlook the yard over the south wall, which is the lowest side of the block, and will overlook every door in the yard.

Fourth, the position of the house will have the best aspect, that is, a south one, for the living-rooms, and a north or north-east aspect for the dairies, which is the one most desirable for keeping milk or meat.

Fifth, the house will partially hide the buildings when seen from the front, and will give the place a more pleasant aspect as a dwelling.

And as many tenants will prefer a farm which is a pleasant residence to one which has no advantages of that sort, these farms will enjoy a greater competition and command higher rents and a better class of tenants than where these advantages are wanting.

The farmhouse should be as near the buildings as is convenient, but should not be either joined on to them or too far off—the one is unhealthy and uncomfortable and the other is inconvenient.

If there is plenty of room for a waggon laden with hay or straw and with two horses in it to turn round between the large doors of the fold-yard and the back-yard of the house, this will be found to be sufficient, and there will be no advantage in having the house much farther or any nearer to the south side of the buildings than this.

The principal requisites for every farmhouse are, a good kitchen, a good dairy, and a good larder or cellar.

These are requirements common to all-sized farms, and ought to be the foundation of all plans of farmhouses.

The size and extent of the living-rooms and the number of bedrooms must depend on the size of the farm and the amount of money which the owner of the land is willing to spend; but care should be taken, particularly in the better class of houses, not to suppress or throw into the background, so to speak, those parts of the building which are essentially necessary to the carrying on of the business of the farm.

In small occupations I should think it preferable to have *one* large, good, well-ventilated room to serve as dairy, larder and cellar combined, than to have

two or three small inconvenient places. For anything over 150 or 200 acres, there should not be less than five bedrooms, and six would be better.

In a house with this number of bedrooms there should be, on the ground-floor, a best parlour, a living-room and cooking kitchen, a scullery, a dairy, and a larder and cellar combined.

I may take this opportunity of saying that the exterior of a farmhouse should always be of white brick or red brick or stone, and never painted, colour-washed, or stuccoed.

A tenant farmer in the country cannot be expected to bestow the same labour and money on his dwelling-house that is required from a town resident, and if the farmhouse is done with colour-wash, or stucco or paint, if it is neglected it will soon look shabby, and depreciate the appearance of the farm, and if it is kept in order will entail too great a cost on the occupier.

The water supply of a farm is, I need not say, a matter of the greatest importance. Water for the use of the farm can be obtained from four different sources, namely: from a well, from a running stream adjoining, or from a pond, or by storing the rainfall in a tank.

The second and third methods of obtaining a supply do not call for any particular observations, but most farms have one well or more sunk near the house; a good many are spouted.

In my opinion every part, both of the house and buildings, should be spouted; for two reasons: first, in order to obtain as good a supply of rain water for washing purposes as can be obtained, and secondly, to keep the house, buildings, and land adjoining as free from wet as possible.

The water that falls as rain on the roofs should be conveyed by the spouts to a cemented tank, or if it only comes from a small quantity of roofing, to one or two hogsheads placed on stands. If a tank is made it should be above the ground; it is easier to clean, and it is easy to see if it leaks, whereas where it is under the ground it is impossible to tell whether it is watertight, and the soft water may be running out, or the hard water contained in the ground may be soaking in, without there being any means of detecting it.

Again, if the tank is above ground, the only thing required to obtain the water from it is a tap, whereas if it is below the ground it is necessary to put down a pump, and it is difficult to see what advantage there can be in letting the water which is, to begin with, at a higher level than where you want it, go down to a lower level and then have to be pumped back again before you can use it.

One or more wells will be required about a farm, one for the use of the house, and one near the stack-yard for the use of the fold-yard, and also for supplying water for threshing purposes.

In the foregoing description, the details relating to the proportion and size of each individual part, such as height of eaves, width and height of doors, dimensions of loose boxes and cow-houses, &c., will be found to apply equally whatever be the size of the farm or occupation, from a small holding of a few acres to a thousand-acre farm.

In the amount, however, extent of the buildings, and general arrangement of the plan, the buildings are adapted, as I stated at the outset, to a farm of from two hundred to three hundred acres chiefly arable, in the case of the larger of the two plans, and to holdings of from fifty to eighty acres in the case of the smaller plan.

There are numberless farms of this description scattered throughout the country, most of which are already supplied with buildings more or less incomplete, and I have endeavoured, in the description and arrangement I have given, to provide my readers with a plan of buildings which will best enable them to see their way to supplementing defects and making additions to existing buildings, and for this reason I have, as far as possible, detached each side from the others, so that any one side of the plan can be taken by itself and added on to a previously incomplete set of buildings.

When, however, the farms are from five hundred to a thousand acres in extent, a much larger quantity of buildings, and consequently a different arrangement, will be required.

A farmstead constructed on the plan I have given, and of a size suitable to such farms as these, would be much too cold and open, and would contain much too great a proportion of uncovered yard to be on the best plan. A steam-engine also would often be in use on a large farm, provision for which would be quite out of place on a smaller holding.

The rule ought to be (in considering the amount of buildings to be erected, and the amount of money to be spent over them), not to *overweight* the farm with interest on the buildings.

In considering how much money ought to be laid out in buildings on a farm, the *rent* is a safer guide than the area: that is, a farm of say five hundred acres of land sufficiently fertile to let at fifty shillings an acre, will carry more expensive buildings than a farm of a thousand acres which is only worth fifteen shillings an acre, for this reason, that the gross produce of the smaller farm will be greater each year than the gross produce of the larger one, and therefore there will be a larger amount of money from which to deduct the interest of the money spent in building.

A large farm may be said to be much the same as an aggregate of smaller farms; and similarly a set of buildings suitable for a large farm may be constructed so as to resemble a collection of smaller sets of buildings. Thus a large farm does not as a rule consist of fields proportionately larger than those on a smaller one, but of a greater number of them, and in

the case of the buildings, the shed and yard accommodation is not gained by constructing a larger shed and a larger yard, but by having several sheds and yards, each the same size as those on a smaller occupation.

In this case, then, the most convenient arrangement is to have one long building forming, say the north side of the block, and three or four shorter buildings at right angles to the longer one on the south side of it, with facilities of access from one to the other.

This will have the effect of cutting up the space allotted to the buildings into three or more compartments.

It will be found desirable in this case to allow the two outside buildings on the east and west side of the block to project farther southward than the middle buildings, as it will form a protection to the yards from the east and west winds.

In constructing a set of buildings for a small holding, or in making additions to one already constructed, the plans I have given will be sufficient to enable the builder to carry out the work; but for larger holdings, where the buildings are greater in extent and necessarily more complicated in construction, it is desirable to obtain the services of an architect, as no amateur, however much attention he may give to the subject, can do as well as a man whose profession it is.

I will, however, give my readers some data which will enable them to give proper instructions to the architect as to the nature and extent of the accommodation they require, as this is a matter which is more within the province of an agriculturist than a professional architect.

We will begin with the accommodation required for the working horses.

The rule here is, on soil which is not strong clay, to allow four horses, that is, two teams, to the first hundred acres of arable land, and three horses to each succeeding hundred acres; that is, a farm of three hundred acres of plough land will require ten horses to work it. When the farm reaches much larger dimensions, a slight reduction may be made in the proportion of cart-horses to each hundred acres. When the land is strong clay, a greater proportion of horse-power is required, but even here I should incline rather to employing a larger and heavier description of animal than to increasing their number.

The size of the farm then will provide the constructor with the amount of stable room required for the working horses.

We next come to the cow-houses; in this case it is impossible to give explicit directions as to the quantity of accommodation required, as it will depend more on the requirements of the occupier, and not on the extent or value of the farm. On two similar

farms, one in a dairy country and one elsewhere, the accommodation required would vary to a great extent, and what one man would consider barely necessary would be considered by another a ridiculously superfluous quantity.

In this case, therefore, the architect must be guided by the *custom of the country*, and not by the size or nature of the farm. It may be thought at first sight that the requirements of the tenant who is going to occupy the farm is a sufficiently good guide, but this is not so.

If they were built on this principle, the tenant for whom they were built might vacate his farm a short time afterwards, and the owner might have several tenants in succession before he met with another who required the same accommodation. Whereas if he had constructed his buildings to *suit the locality*, he would be practically constructing them to suit all the tenant farmers in that part of the country.

The next consideration is the amount of shed-room or accommodation required for what is technically termed straw-yard beasts, that is, store beasts which are kept for the purpose of growing bigger, as distinguished from those put up to fatten.

Here neither the acreage of the farm nor the locality ought to be the guide; but the *fertility* of the farm must be taken into account. The fertility of the farm, that is, the goodness of the land, is measured in the first instance by the *rent*, and the *rent* of the

farm therefore (I am speaking now of arable land) should be the guide to determine the amount of money it will be found judicious to expend in putting up sheds.

In addition to the buildings above enumerated, accommodation will be required for breeding stock, and for rearing young animals.

In this case nearly similar accommodation will be required, whether for breeding horses or cattle; and as on nine farms out of ten a larger number of cattle ought to be reared than of horses, the nurseries, so to speak, should follow the cow-houses, and not the stables. Roomy loose boxes and small sheltered yards are the principal things required, and as a man who breeds his own stock will always have an advantage over a man who has it to buy, inducements should be held out to tenants to raise their own stock by providing them with every facility for doing so, and in this department liberality should be the order of the day, and as much provided as the owner is willing to pay for. Here, then, the purse of the owner must regulate the outlay within reasonable bounds.

This part of the farm buildings is, as far as my experience has gone, by far the most neglected and insufficiently supplied of any part of the buildings.

I feel sure that if any of my readers acquainted with a large extent of district will tax their memory, they will agree with me that if ever they found a

patched up rickety hovel, made of all sorts of odds and ends, and forming an eyesore to the rest of the buildings, it would prove to have been a building constructed by the tenant to house some animal with young ones, and which he had put up himself because the necessary accommodation for the purpose had not been provided.

I may here point out that as a box which is big enough to hold a mare and foal comfortably is big enough to hold any of the other stock on the farm, it will be advisable to construct some at least of the loose boxes sufficiently large for that purpose.

As regards the accommodation for pigs, I have given already a plan for the best construction of pig-sties, and I will only here point out that as any other description of building will accommodate a pig just as well as a pigstye will, but that a pigstye will not accommodate any other description of stock, it will be advisable to have as small a proportion of the buildings devoted to piggeries only, as possible.

To sum up then the buildings devoted to animals.

The *size* of the farm must regulate the size of the stables.

The *rent* of the farm should regulate the amount of shed-room.

The custom of the country should be the guide in building the cow-houses.

The ability to pay for them should limit the accommodation for breeding-stock.

While the pigsties may take their chance, and be regulated by the proportion of space in the buildings which requires to be filled up in order to complete the plan.

It should be borne in mind, however, in constructing any set of buildings, that loose boxes are the backbone of stock feeding and rearing, and you can hardly have too many of them. In fact, loose boxes play somewhat the same part in the construction of farm-buildings that Traddles' tea-table played in the domestic economy of his establishment, as described by him in the pages of Dickens' novel of 'David Copperfield:' thus,

You have a sow and litter of pigs, and want a place to put them in, and 'there you are.' You buy a calf at the market and want to keep it to itself for a day or two to see if it is all right, and 'there you are,' &c. &c.

The advantages appertaining to the use of covered yards instead of open courts are, first, that the beasts are kept wholly under cover, and are not exposed either to the rain or wind; and secondly, that the manure made in them is better than that made in an open yard; in the latter a great quantity of what is probably the richest part of the manure is carried away by the rain which falls on the manure during the winter.

The second of these advantages is very considerable, the first is more or less important according to

the age of the animals which are kept in the yard, and their ultimate destination.

Where the beasts are going from the yard to be tied up in feeding boxes, a covered yard is of great benefit, but in the case of young growing beasts, which are destined to be turned out in summer, there are disadvantages as well as advantages.

Young beasts in a covered yard will thrive better *while they are in the yard* than they will in an open one, but they will not thrive so well after they are turned out, as they will have become tenderer and more susceptible to cold than beasts which have run in an open yard.

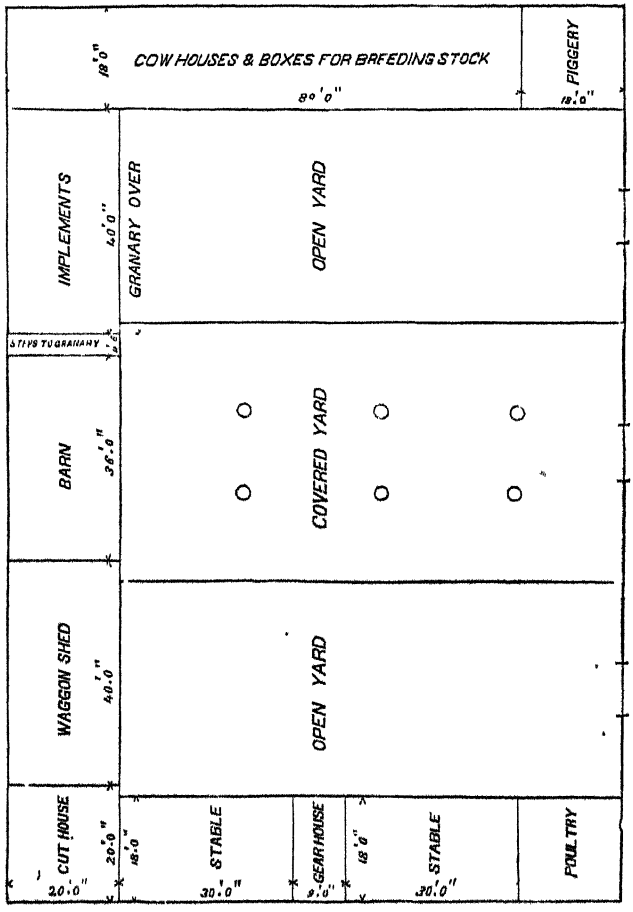
It is much more the fashion to keep beasts in an artificial state now than it was in the earlier days of shorthorn breeding.

I find in Bell's 'History of Shorthorns,' that Mr. Bates, the original breeder of the class of shorthorns which still bears his name, was in the habit of letting his young stock run, winter and summer, in an open common a great elevation above the sea, and they were only brought under cover when three years old.

Again, in the Home Farm at Wiseton of Lord Althorp, the shorthorn breeder, the crew-yards contained absolutely no shed-room at all.

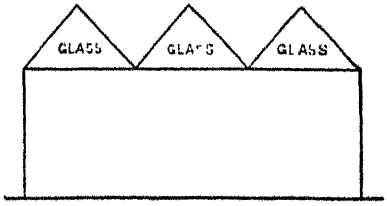
What a contrast to the way in which the descendants of these animals are treated in the present day!

The objections to the covered yards which I have seen are, first, that sufficient care is not taken to


CUT HOUSE
20'0"
20'0"
WAGGON SHED
40'0"
BARN
36'0"
STIPS TO GRANARY
IMPLEMENTS
40'0"
18'0"
COW HOUSES & BOXES FOR BREEDING STOCK
80'0"
PIGGERY
18'0"
GRANARY OVER
STABLE
30'0"
OPEN YARD
COVERED YARD
OPEN YARD
GEAR HOUSE
9'0"
STABLE
30'0"
POULTRY

avoid draughts or currents of cold air; and, secondly, that the same roof which keeps off the rain also keeps out the sun.

The first objection may be avoided by care in the construction, and the second objection may be obviated by having some part of the roof made of glass. If the roofs of the building were made to run north and south, and the gable-ends at the south end were filled up with glass from the eaves to the ridge, thus—



it would have the effect of admitting a considerable quantity of sunshine into the yard; and as the angle of the sun is much lower in winter than in summer, it would admit the greatest quantity of sunlight in winter, when it was most wanted. I have given a sketch supplied to me by Mr. Goddard, of Lincoln, of an arrangement of farm buildings with one covered and two open yards. The part marked for implements may be used (if more shed-room be required) for animals, and the implements housed in a separate building.

CHAPTER III.

ON THE DAIRY.

As the supply of cereals from other parts of the world increases, and the profit of growing them at home, in consequence, diminishes, the tendency is becoming greater of adapting the agricultural land of this country to the breeding and rearing of stock, and to the production of the articles of the dairy: milk, butter, and cheese.

The dairy itself, therefore, which has up to now been an almost neglected part of the economy of the farm, except in those parts of the country which have been devoted exclusively to what is technically called 'Dairy Farming' as a specialty, will very probably have in future to play a more important part.

In most cases on ordinary-sized occupations, the dairy forms an integral part of the farmhouse and offices, but where it can be so arranged it would be found to possess many advantages if it were an entirely separate building.

This would give the great advantage of a free current of air all round the dairy, and would admit of its being placed at a sufficient distance from any

traps, drains, &c., to insure purity of air, which is not an easy matter when joined to the house.

The dairy should be constructed partly below the ground and partly above, so that the milk can be kept sufficiently cool to prevent it becoming sour in hot weather, by being placed below the level of the ground, and at the same time have the advantage of the sun in winter, when the new milk requires warming to make the cream rise properly.

As to the aspect of the dairy—that is, on which side the windows ought to be—different opinions have at different times been held, but a north aspect is the safest, if there is only one; but in the case of a detached building, a window could be constructed on the north or east side, and another on the south side, and the south window could be blocked up in summer when heat is to be feared, and the north window blocked up in winter.

The eaves of the roof should project a considerable distance beyond the walls, enough to form a verandah on every side but the north, and a double roof, or a ceiling made at a considerable distance from the slates or tiles, will be found beneficial, as it will make the dairy cooler in summer and warmer in winter.

The principal utensils in use in the dairy are bowls for the milk, pancheons for the cream, and a churn for the butter. Of these bowls have been used at different times of lead, tin, earthenware and glass.

The objection to having the bowls made of lead is that they are not easily cleaned, while glass is found to be too brittle, and earthenware is therefore the best material of the three.

The cream is usually taken off the milk by a skimmer, but a syphon has occasionally been employed, and its use might be adopted with advantage more generally than it is.

A syphon is a bent tube with one long end and one short one, and on being placed on the edge of the milk-bowl in such a position as to have its short end in the milk and its long end hanging over the edge, the milk will run through the syphon as long as the short end is under the surface. It can be started either by filling the syphon with milk to begin with before inserting it, or, which is the better way, by having a piston inserted in the longer end which can be removed; by this means the syphon can be filled with milk after being inserted in the bowl, in the same way that a squirt is filled.

In using a skimmer the cream is taken from the milk, in using a syphon the milk is taken from the cream.

The shelves of the dairy are best constructed of wood; if of stone or slate, there is much greater danger of breakage if the dairy-maid should chance to hit the bowls against them.

CHAPTER IV.

ON FARM ACCOUNTS.

Some time ago one of the numerous Agricultural Societies which are dotted over the United Kingdom resolved to offer a substantial prize for a book containing the best system of accounts on bookkeeping, adapted to the use of farmers. As might be expected, a great many competitors appeared on the scene, a great variety of account books were sent in. The time arrived for the committee appointed to decide the matter to make their award, when, to the surprise, no doubt, of the competing parties, they announced that not one of the books or systems sent were sufficiently good to get a prize at all. The reason given was that they were all too complicated.

If I had been a competitor for this prize, being at the same time an occupier of a farm, I should have adopted the following method of building up an account book.

I should have purchased a number of penny memorandum books, and whenever I found I wanted to put anything down, I should have entered it in one of the books, keeping each book for its own particular

department. At the end of the year I should have bound all the books up together and submitted the result to the committee.

If any of my readers feel inclined to adopt this plan, I can promise him that he will find himself, at the beginning of the second year, in possession of an account book on a better system than that of any he can buy. But without adopting this rough and ready method which labours under the objection of taking a year to complete it, I will endeavour in this chapter to point out what are the principal things a farmer requires to be inserted in his system of accounts in order to best give him a correct idea of what he has been doing during the year, and how he stands at the end of it.

To begin with his cash transactions. The farmer will require to know how much money he has paid away during the year, and how much money he has received; but in addition to this, he will also want to know for what he has paid it and for what he has received it. He will therefore want a department for payments and another for receipts, but each department will want to be divided into as many heads as he finds necessary. To begin with his payments: these may be divided into payments made to people for work done, and payments made for things bought; the payments made for labour performed may, as I will endeavour to show presently, all be included under one head, but this should not be done in the

case of things bought or paid for. Under this item there should be a broad distinction drawn between anything which is purchased with a view of being sold again, or of producing anything to be sold again, and any other money laid out. Thus, for instance, any stock bought should be entered in a column marked *bought*, because the opposite thing that will happen to it will most likely be that it will some time be sold, when it will be entered *sold*. Any implement purchased, on the other hand, should be entered in a column marked *paid for*, as it will not be intended to be sold again but to be used upon the farm; this will also apply to any manure or feeding stuff purchased, and in fact to all tradesmen's bills.

Anything produced on the farm and sold should come under the column marked *sold*. In the case of agricultural horses used on the farm, the farmer may feel puzzled at first to know in which column to enter them; but I will give him a rule as a guide. If he is in the habit of selling carthorses which he has bred or produced on the farm, or bought young and kept at work till they grow up; in this case the farmer should enter all carthorses parted with as *sold*, for they may fairly be considered as part of the stock of the farm, and when purchased should, in like manner, be entered as *bought*. When, however, carthorses are only used for working the land, if a carthorse is purchased it should be entered among the things *paid for*, not among the things *bought*; but when a carthorse is

sold, for whatever reason, it should be entered among the stock *sold*, for this reason, that every outlay is not an investment, but everything sold brings grist to the mill. A most important column, which is never inserted in farm account books, is one in which to enter all *bargains* made of whatever sort, and which should be headed BARGAINS. In this column should be entered all contracts for work done by take, that is piecework, and this will obviate the necessity of having more than one column for outlay in wages. When anything is sold, it should be entered in the column on the day sold, and if not paid for at the time, should be marked with a tick when it is paid for. This will be found a much simpler plan than having a column for money received. Many farmers will require a diary in which to enter the dates on which different things occur; but this should be a separate book, and should not form any part of a system of accounts. The items I have given above will be found sufficient to keep straight the ordinary run of farming accounts, and to give the farmer the requisite information as to how things have been going on during the year. It will be seen that it consists of five headings thus:—

Wages paid. | Paid for. | Bought. | Sold. | Bargains.

It is a usual thing in making up farm accounts at the end of a year for the farmer, or someone on his behalf, to make a valuation of everything he has and compare it with a similar valuation made the year

before. This is the common practice, and is, I think, a faulty practice in continuous or running yearly accounts, that is, where a farmer has no intention of leaving, and where there is no alteration of his system of farming. In these cases, as for instance where a farmer keeps a breeding stock of 100 ewes or a herd of 20 milk cows, it would be better, I think, to draw the 100 ewes and the 20 cows, and put them in a separate field and proceed to the valuation without them. The reason for this is that the *valuation* is governed every year by the market price prevailing at the moment, and that the price put on the animals will vary very greatly in different years, whereas the *market* price of the farmer's flock is a matter of no moment at all to the farmer, unless he wants to sell them, and they are of just as much value to him when they are selling badly as when they are selling well.

For the same reason, I should exclude altogether all the implements, and put down any money spent in replacing them to the outgoings of the current year, and the same with the carthorses.

CHAPTER V.

ON BUYING AND SELLING.

Buying and selling forms an important feature in the business connected with farming. A man may be a good practical farmer, but if he is a bad buyer and a bad seller, he will not do as well as a man who is a good one. Every farmer, however, has a great power of expanding or diminishing the number of his operations in buying or selling, according to the manner in which he farms. If he is a good judge of stock and a good judge of the market value of them, it may answer his purpose best to be frequently changing his stock, as by this means he will turn his money over quicker and will have more opportunities of profiting by his good judgment. If, on the contrary, he is not a good judge of stock, or if his avocations are such as to prevent him from frequently attending the market, then his best plan will be to be a producer rather than a jobber, to breed animals in preference to buying them, and to keep those he does buy a considerable time before he parts with them.

In cases where a person engaged in farming is compelled, or prefers, to employ some agent instead

of doing his buying and selling himself, it is better to entrust the selling of stock to others rather than the buying, for this reason, that if a man sells badly for you he can only injure you in the price, but if he buys badly for you he can injure you both in the selection of the animals and the price he pays for them.

For this reason I should advise anyone commencing farming always to buy his stock for himself, and do as he thinks fit about selling them. People who are ignorant of the market value of animals can often judge better of the merits of a beast or sheep than a man who attends every market and knows their exact value, for the latter will often be led to lose sight of the difference between a good animal and a cheap animal, and will be tempted to buy the animal which he can procure on the most favourable terms. If animals purchased are to be sold again shortly, the price is of more consequence than the merit of them, and the longer they are going to be kept, the more important their merit and the less important their price is; and in the case of breeding stock, where the animal bought and its progeny may be kept for several generations, the merit of the original animal is of the highest importance, while its price, within certain limits, is of little or no account.

Anyone, therefore, beginning farming, will, I think, do best if he buys for himself, but gets someone else to sell for him. He may select badly and pay too much at first; but in the case of the first he

will find that what pleased him at the market will please him at home, and *vice versâ*, while in the case of the second he will soon learn better.

He may very likely commence by going about a market with a jovial expression, showing to everyone that he has come to buy something, and has got the money with him to pay for it, and may make a transparent attempt to conceal his intentions by asking the price of half a dozen lots he does not want, and will no doubt be astonished at the high prices asked, and the great store set on the animals by their owners; but he will soon mend of this, and learn to assume the dejected appearance desirable on such occasions, and to try (if a stranger) to appear as much as he can like a man who has got nothing to spend, when he will have some chance of getting to know what price the sellers will really take.

An auction will perhaps be the best place at which to purchase stock at first; but let him beware of the common mistake of thinking that everyone else but himself knows the exact value of what is sold, and that he has only to give a trifle more than the last bidder to get what he wants at the market price.

Great is the joy of the auctioneer and the seller when two such customers get together, and bid against one another, each trusting to the other to stop at the right time.

CHAPTER VI.

ON THE IMPLEMENTS COMMONLY USED.

THERE are a great number of implements that *can* be used on a farm, and their number appears to be constantly increasing. There are a few implements which *must* be used on a farm, and I propose here to confine myself to those, and to give a list of them, and a slight description of each, taking them in the order in which they would have to be used.

The first implement is the plough, which is the first to be used, as a man must always start by ploughing his land unless someone has already done that for him. The plough is the oldest of agricultural implements, and has varied less in its construction during the lapse of two thousand years than any other. If an ancient Roman could be shown most of our modern implements of husbandry he would not even know for what purpose they were intended, but he would recognise a plough at once, from its similarity to the implement he was accustomed to use for a similar purpose.

Ploughs are made of two kinds; long-breasted

and short-breasted. The short-breasted is best adapted for sand, while the long-breasted is generally used in clay. The reason for this is, that the long-breasted plough, like the narrow-bowed ship, offers less resistance to its passage as it goes along, and for this reason lightens the draught to the horses, which is a great desideratum in clay; while in sand an ordinary pair of cart-horses can pull almost any shaped plough, and therefore the plough which is handiest and most convenient to the ploughman, which is the short-breasted plough, is principally used. Of late years a plough called a double-furrow plough has been introduced. It consists of a plough with one pair of handles and one beam, and two breasts and shares, thereby turning, as its name indicates, two furrows at once. It is drawn by three horses on light land, and the object of using them is to save labour both of man and horse. Two men with six horses will plough as much as four men would with eight horses if single ploughs were used. They are only suitable for light land, and cannot be used where there is much rubbish growing.

The next implement to mention is the drag. The simplest form of this is a stout wooden frame with two rows of iron teeth about ten inches long, slightly curved forwards, and a pair of handles something like plough handles. It is drawn by three or four horses, and is used after the land has been ploughed and cross-ploughed.

The next implement used is the harrows, con-

sisting of a smaller frame and shorter, lighter teeth. These are drawn without being held by the driver, one harrow being used for each horse, that is, two horses will pull two harrows, and three horses will pull three harrows.

After the land is harrowed once or twice, a light iron roller is run over it, and it is then harrowed again. The roller is drawn by one or two horses, according to its size. The next implement used is the chain harrows, which is simply a large square net-work of iron rings. This is drawn by two horses, and its work is to roll the twitch or couch grass up into heaps and shake the sand out of it, and leave it in heaps convenient for forking together, and then burning or carting away. These constitute the whole of the implements used in cleaning the land, the operations being repeated until the land is ready to sow. The implement used in sowing is called a drill, of which there are two sorts, one sowing two rows at a time, about 2 ft. 6 in. apart, and which is used for sowing root crops, and the other, a much larger one, sowing eight or ten rows at once, and used to sow corn.

After the crops are sown, the only implement used during the growth of the crop is the horse hoe, of which, like the drill, there are two sorts, one for corn and one for roots, the latter taking one row and the former five or six. Of these the turnip hoe is used freely as long as the size of the plants will admit it

to pass; but the corn hoe is only used once, or at most twice.

The implements used for cutting the corn crops are the reaping machine, the mowing machine, the scythe, and the sickle. The latter is now nearly obsolete, and the scythe is chiefly used on small occupations and in places where the larger machines cannot work. The reaping machine is used for corn only; the mower for grass, and occasionally for spring corn, but not for wheat. They are drawn by one, two, or three horses, according to their size and the breadth of the cut.

The grass-mowers now in use would, I think, be much improved by making the wheel at the end of the knives larger, and, if possible, the same size as the driving wheels. Whenever the machine breaks, it almost invariably turns out that the breakage is caused by the small wheel meeting with some obstruction which it cannot surmount.

The implements used for harvesting the crop are the waggon, the Scotch or square cart, and the harvest cart. Of these the harvest cart is the most convenient; but as ordinary carts are required for other purposes, they are the most economical; but they should not be used in a hilly country, as they throw too much weight on the horse's back when going downhill, and are apt to take him off his feet when going uphill.

After the corn is harvested, the next implement, or rather machine, used is the threshing machine.

When these were first introduced they were usually worked by horse-power; but this practice has been long discontinued, the horse-power being now used chiefly for cutting hay, straw, &c., for the cart-horses and beasts, and for pulping roots, and sometimes for grinding: the threshing machine being now driven by a steam engine.

These engines are as yet generally constructed of the kind described as *portable*, that is, the engine can be taken anywhere to work, but it cannot take itself there.

There are three kinds of steam engines in use in agriculture. First, the fixed engine, only available on the farm on which it is placed. The portable engine, which is at present in use for letting out and going from farm to farm for threshing, and the traction engine, which moves itself about the country, and is at present used for steam ploughing.

It would, I think, be a great advantage to farmers if the present portable engines were superseded by traction engines for threshing purposes.

It often happens that it is a very great inconvenience to a farmer who wants to do a day's threshing, to have to break off all his horses to go and fetch the steam engine, threshing machine, and straw elevator from a village two or three miles off.

If light traction engines were built which could take themselves about the country and pull the drum, or machine, and the elevator, after them, they would

be found to be a great boon to the farmers, and would, I think, supersede the portable engines in the same manner that the portable engines have superseded the old-fashioned horse-power, or the horse-power has superseded the flail.

After the corn is threshed, the next operation is to dress or clean it from rubbish. This is in some cases performed by the same machine which threshes it, but it is more commonly done in the barn, by means of a dressing or winnowing machine, and a blower, driven by a man turning the handle. These machines are sometimes made separately, and sometimes the two operations are combined in one machine. In the dressing machine the corn passes through two or three wire sieves, which are kept in motion by turning the handle of the machine, and the blower consists of a wheel like the paddle-wheel of a steamer enclosed in a box, the wheel being made to revolve rapidly to create a current of air, which is brought to bear on the corn, and which blows out the light corn, grass seeds, &c., and leaves the best corn.

The hecking barrow, which is used to wheel sacks of wheat about, and a bushel measure, eight of which go to a quarter, with a weighing machine, and the necessary forks, shovels, and brooms, complete the list of implements used in the barn.

Wheat is generally sold by measure, that is, by the quarter of two sacks, each containing four bushels, but each sack is guaranteed by the seller to

contain a certain weight, that is, eighteen stone in the case of wheat, so that it is practically sold by weight, and the usual practice of putting up wheat for delivery is to set an empty sack on the weighing machine and pour wheat into it till it makes the required weight, and then to tie it up and proceed to fill another.

Implements used in Feeding Stock.

The implements used in feeding stock, including the working horses, are, the turnip-cutter or slicer, and the turnip or root-pulper; the chaff-cutter and the corn-crusher or mill. They are driven either by hand or by the ordinary horse-power. The object of the turnip-cutter is to cut the turnips or other roots into slices, to make them easier for the animals to eat.

They are generally made to cut slices of one of two sizes, the larger one the whole size of the root for cattle, and the smaller one, the size of a man's finger for sheep. The best description of cutters are made to cut one sized slice if you turn the handle one way, and the other size if you turn it the other way. This construction will be found much the most convenient, as the machine can be used indiscriminately, either in the field for sheep, or in the homestead for beasts, and when used in the homestead the roots can be cut to the large size for the large animals, and to the small size for the calves.

The pulper is simply a similar machine, but its

action on the roots is more like that of a nutmeg-grater, cutting the roots up into a pulp; hence its name. The roots thus treated are generally given to fatting cattle, and are mixed with cut hay, bran, and meal. There is, I think, no great advantage in pulping roots over slicing them for store cattle, and the labour, and consequently the cost, is greater.

The chaff-cutter, as it is commonly called, consists of an oblong box with two circular knives set in a frame revolving at the end of it; the straw or hay to be cut is put into the box, and is cut into short lengths by causing the knives to revolve rapidly; there is a rack-work contrivance in the box, which keeps pushing the straw forward as the knives cut it. The knives are turned by either horse- or steam-power, and the box is supplied with straw, or 'fed,' as it is called, by hand.

On smaller occupations a simpler form of chaff-cutter is used. In these the man has one long knife attached to the machine at one end, and with a handle at the other, and he holds a short fork in his left hand, with which he pushes on the straw, while he cuts slices off it by means of the knife with his right hand, compressing the straw with his foot by means of a treadle.

In addition to the chaff-cutter and the turnip-pulper, a mill to grind or crush the corn is often used, and might with advantage be used more frequently than it is on the smaller occupations. Mills

were formerly constructed solely of stones but iron mills are now introduced by the agricultural implement makers which will not only crush the corn, making it more suitable for horses, but will grind it into meal fit to feed pigs with or even flour suitable for making bread.

When corn is fetching a low price it is a question whether as much money cannot be made of it by consuming it in this manner on the premises instead of selling it. These iron mills can be turned by hand, horse-, or steam-power.

Steam Cultivation.

The practice of ploughing the land by means of steam, although it is of comparatively recent origin compared with threshing by steam, has still attained a sufficient prominence to be entitled to rank as one of the operations of the farm, and for the steam engine and tackle to be classed among the ordinary implements of husbandry. For many years experiments were tried with different kinds of machinery and different methods of working, but the practice which has up to now apparently found the most favour is to have two traction or self-moving steam engines, one at each side of the field with a windlass to each steam engine round which the engine winds a wire rope attached to a frame containing a number of plough-shares.

By this contrivance each engine alternately winds

up the rope, and in doing so draws the ploughs from the other side of the field, the engines moving on as the land gets ploughed until the field is finished.

It would not seem to a casual observer that this is the best method that could be adopted. It lies open to the objection of having not only to buy two engines instead of one to start with, but to have them twice as powerful as they ought to be to do the sam quantity of work.

That is, if two engines, each pulling *half* the number of ploughs, were set to work in a field and could be kept at work continuously they would do as much as they now do in a day, when pulling twice as many ploughs at once but only pulling them one way.

This is a very grave objection to the plan on the score of expense. Two sets of men, one to each engine, are required; two fires have to be kept up, while each engine only works actually half the day.

If this intermittent manner of performing the work could be avoided, it would materially diminish the expense attending steam ploughing, and probably cause a proportionate expansion in the area of land cultivated in this manner.

CHAPTER VII.

ON ENSILAGE, ETC.

WHAT is ensilage? is a question which many of my readers will ask, and what is the meaning of the word silo?

Ensilage may be described briefly as preserved grass, and a silo as the jam-pot in which the grass is preserved. The method of making ensilage is to mow the grass when in the ordinary condition for making hay, and as soon as it is mown, instead of leaving it to wither in the sun as is the plan when it is intended for hay, instead of this, to cut it up into short lengths, something in the manner in which hay and straw is cut for cart-horses to eat, and after it is cut, to store it in a proper receptacle while it is still green, applying great pressure by means of either weights or levers in order to compress it into the smallest possible compass as well as to drive out all the atmospheric air possible, to intermingle slight applications of salt between the layers of the ensilage, and when the pit or building in which the grass is stored is full, to hermetically seal it in order to exclude the action of the atmosphere and leave it

until winter, and when the building is opened the grass in the state in which it will then be found is called ensilage.

The discovery of the practicability of thus preserving grass until winter without losing its succulent or juicy qualities was, I believe, first made in America. When introduced into this country it was tried as an experiment on a small scale by a few people, and being found to give good results, soon attracted the attention of the educated agricultural world generally, and is now being tried in almost every variety of shape and way all over the country.

The advantages claimed for ensilage are :—

1st. That it supplies the place of green food at a time when there is no green food to be procured off the land, and thereby gives the animals the benefit, so to speak, of a summer's run in winter.

2nd. That it produces, in the case of milch cows, a larger quantity of milk than can be obtained from the ordinary winter food.

3rd. That as it is not necessary that the grass should be absolutely dried when stored in the silo, it is practicable to make ensilage in weather in which it would be very difficult to make hay.

It is probably the last-named qualification claimed for it which has caused public attention to be so widely directed to the subject.

For the last few years haymaking has been carried on under considerable difficulties as regards weather,

and people have hailed with avidity any plan which will either enable them to dry the hay independent of the weather or to preserve the grass without its being dried at all, and this latter condition the practice of turning the grass into ensilage seems to fulfil.

We now come to the receptacle in which the grass treated as I have described above is stored.

In this case, as in that of most other new discoveries, a certain time must elapse before the dimensions and mode of construction considered most suitable is fixed by public experience. The conditions required appear to be, first, that it should be dry and watertight; secondly, that it should be capable, when filled, of being hermetically sealed to exclude the air; and, thirdly, that it should be so constructed as to bear the lateral pressure caused by compressing the grass.

In addition to these a movable top is necessary, as it is found that however great a pressure is put on the grass to begin with, there is still a settling or shrinkage which requires to be either filled up and made good by inserting fresh ensilage into the silo, or by letting the lid or covering of the silo sink as the ensilage diminishes in bulk, the difficulty in both cases being to accomplish the object without letting in atmospheric air, which is found to have a prejudicial effect on the keeping properties of the ensilage already stored.

Subject to these conditions, almost any receptacle

can be applied to the purpose from a beer barrel to a gasometer. The silos may be constructed either of wood, iron, or brickwork; they may consist of pits sunk in the ground, or of buildings erected above; but in the case of pits sunk in the ground, the difficulty of avoiding damp will be greater, though the facilities for compressing the grass will be greater, and difficulty of excluding the atmosphere will be less. In low, flat countries it will be more advisable to construct the building above ground.

In many cases, where the occupier of the land may happen to have two sets of buildings, one of which he does not require, it will not be found difficult to make use of an old barn, and the expense of converting it into a silo will be less than the cost of building a new one.

I have mentioned above that the two conditions involving the greatest difficulty at present in the making of ensilage are the compressing of the grass to the requisite extent, and the exclusion of the atmosphere when the stack is completed.

The modes hitherto adopted of compressing the grass are three, first, throwing in small quantities of grass at a time, and beating each layer firmly down by the use of instruments resembling a pavior's rammer, used to give a firm surface to the stones on a fresh made road.

Second, to have a movable lid to the pit or building, and apply the pressure all over at once by means

of weights; and, third, to compress the grass by the use of levers.

The difficulty attending the first-named method, namely, ramming, is to get the pressure applied equally all over the surface.

The difficulty attending the second is the great weight required to give the requisite pressure over the whole surface at once.

And the third method requires an apparatus constructed on purpose.

Beating the grass down with a rammer will probably be found the best when experimenting on a small scale, as the outlay involved in providing materials to work with will be small; but where a larger surface is required to be pressed it would be difficult, if not impossible, to get each workman to do their work exactly alike, so as to produce a uniform pressure, and some parts would be found to be faulty when the pit came to be opened.

In the case of using the power of a lever to compress the grass, it would, I think, be found practicable to compress the grass in blocks of, say, a cubic yard, by means of a frame of this dimension, with a screw or lever attached to it.

In this case the grass would be compressed (after being cut into lengths) *before* being placed in the silo instead of after it has been placed there, and in small quantities at a time instead of over the whole surface at once.

A machine constructed on this plan is now in use for compressing trusses of hay. It is easily moved about from place to place, and the pressure is applied by one horse walking round in a circle at the end of a lever.

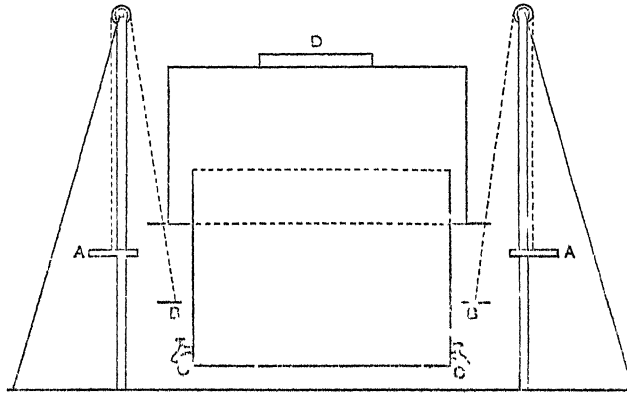
As regards the building or pit prepared for the storing of the ensilage, it will no doubt be the case for some time that present existing buildings will be adapted and used instead of new silos built for the purpose. Pits may be constructed with advantage where the ground is on a declivity, so as to afford a ready means of draining away both the soakage of the ground and the moisture of the ensilage; but these can hardly be constructed where the ground is flat, on account of the water, and in these cases the building will have to be erected above ground. Where the silo is intended to be a permanent addition to the farm, and has to be constructed entirely of fresh material, it is a question whether it would not be found best worth while to have it constructed of iron on the same plan on which a gasometer is now constructed—that is, a circular iron pit of the required dimensions, with a circular iron cover fitting tightly on the pit, in the same manner as the lid of a band-box fits on a band-box.

This lid is raised and lowered by chains attached to it which pass over pulleys, and have weights attached to them.

By having a silo of this construction, the pressure

could be regulated, and the lid or cover could be made to sink as the ensilage diminished in bulk.

I have inserted a sketch of a silo, designed as I have described, in section.



It will be seen by the drawing that the lid or cover of the silo is suspended by four or more chains attached to the bottom of the lid, and passing over pulleys which are fixed on the top of stout iron or wood posts (telegraph posts might be used for this purpose) stayed with galvanised wire as shown in the drawing.

It will be seen that by applying weights to the other ends of the chains at A, A, the weight of the lid would be balanced, and the lid could be raised by applying more weight on the chains than the weight of the lid.

When the silo was filled, and it was desired to apply the requisite pressure, the weights would be taken off the ends of the chains which pass over the pulley, and applied to the short chains attached to the lid at B, B. By increasing these weights almost any amount of pressure could be applied, in addition to the weight of the lid or cover itself.

The grass could be put in through a door, D, on the top of the lid, which should be securely fastened when the silo is full, and the liquid could be allowed to run out through taps, C, C, at the bottom.

The first mention of anything approaching to the storing of grass in its green state as cut occurs in 'The Ride to Khiva,' written by Colonel Burnaby. At page 243 I find the following paragraph:—

'We now encountered a party of men and women, who were engaged in unearthing a quantity of grass from a deep cutting in the ground.

'This grass had been mown in the previous autumn, and was thus preserved until such time as the owner required it, the extreme cold, or perhaps the dryness of the air, keeping the grass as fresh as the day it was cut.'

This was published in 1875.

PART IV.

CHAPTER I.

ON THE LAWS THAT GOVERN THE RELATION OF CAPITAL AND LABOUR.

What is a fair day's wages? is a question that has often been asked by political economists but never very satisfactorily answered. One man will say, a fair day's wages is a sum that will enable the workman to live. Another will say, a fair day's wages is such a sum as an employer can afford to give, having regard to making a reasonable profit for himself; these are both excellent definitions in their way but, unfortunately, they are only right when there is such a profit on the transaction as to enable both parties to feel satisfied with what they receive. It often happens, however, that the sum to be divided between the employer and the employed is not sufficient to furnish what will enable the workman to live in comfort and the employer to get a fair profit, and then both these definitions fail.

Other writers will say that the amount of a day's wages will depend entirely on the law of supply and demand. This is right to a certain extent, but is faulty as a definition, inasmuch as it does not give

any starting-point, or point of departure, from which the law of supply and demand can begin to operate.

We can imagine a case in which the state of supply and demand are equally unknown to both parties, or for some reason does not exist, as for instance in the first bargain of the kind ever made between two parties. I will give an illustration.

Let us suppose two men meeting one another in a deserted and sterile land, both of them hungry and thirsty, and one of them carrying a loaf of bread and the other a bottle of water. Here each wants something that the other, and no one else so far as they know, can supply them with. Under these circumstances one is naturally led to conclude that they would share the loaf and the water equally, and that if they did not do so it would be because one of them wanted what the other had to a greater extent than the other wanted what the first had. We therefore take it that the following is the correct way of putting the case, and furnishes us with the *first* great law regulating capital and labour, which is this :—

In all transactions between one man and another, anything other than equal division must depend on the law of supply and demand.

We will now go a step further in our illustration and suppose that one of the men, having exchanged half his loaf for half a bottle of water, proceeds on his way without eating or drinking what he has got, and

meets a third man, hungry and thirsty, but with only a loaf of bread; in this case one of the men is absolutely without one of the things necessary to him, while the other, although having less of each commodity than the first has of the one commodity he possesses, still has enough for his actual necessities. In this case it is easy to see that the man who has both bread and water will not be willing to divide on the same terms as he did the first time, but will demand and probably succeed in getting a larger equivalent of bread than he parts with of water; this leads us to the *second* great law in bargaining, namely:—

That in the earlier stages of a thing, the man who is the most independent of the other will get the advantage.

Here the law of supply and demand is brought to bear directly and forcibly on the two parties making the exchange.

And this, that is in the earlier stages of the business, is the only time when the law of supply and demand controls the whole of the transaction, as I shall endeavour to show by continuing the illustration.

Let us now suppose that the first-named man who has now met two men each having only half what they want, and whom we will call A. for the sake of easily distinguishing him, let us suppose that he continues on his road and meets in succession a series of men, B. C. D. &c., bearing alternately bottles of water and loaves of bread.

In this case A. will soon conclude that there is a supply both of loaves of bread and of bottles of water but that they are in different hands, and that he himself is in possession of two advantages over the men he meets, first that he has some of both the things in his possession which they have not, and secondly, that he knows that there are a number of each kind of the articles in existence which the others do not know.

In this case A. will have a double advantage over B. C. D. &c., first the advantage of being independent of them, whereas they are not independent of him, and secondly, the advantage of superior knowledge, that is, the knowledge of his power of getting further supplies of anything he parts with, and he will be able to make use of both these advantages to his own benefit.

Here, then, the *third* great law comes into operation.

In all cases of bargaining, when the matter is established and business becomes extended, the man who is in possession of the best information will have the advantage.

CHAPTER II.

ON THE UNEARNED INCREMENT OF LAND FALSELY SO-CALLED.

THERE is a legend extant that in a former history of Ireland there was found put down in the index a chapter headed, 'On Snakes,' and on turning over the leaves of the book till the page indicated was arrived at, the reader found the following, 'There are no snakes in Ireland.'

Without cutting my readers quite as short as this, I would wish to point out that there is absolutely no such thing as any unearned increment in land, and that of all mischievous fallacies hit on by unpractical philosophers, this is one of the most mischievous.

Land of itself is worth nothing and produces nothing of value to man without labour. Land, from the greater development of facilities for cultivating it, or from a greater demand for the articles supplied from it, may command a higher price at one time than another, but it is the *increased opportunity* for earning money and not any money derived without labour, that is getting sold, and the same causes which elevated the price of it may, when reversed, depress it

as much. The value of the right of tilling the land rises precisely in proportion as people want it, and falls in proportion as they don't want it, and is governed by the same fluctuations which causes everything else that has a money value to be worth more money in the estimation of men at one time than it is at another.

CHAPTER III.

ON THE TAXATION OF LAND.

HAVE heard it stated occasionally (I need not say hat it was by people who were neither owners nor occupiers of land) that the country, that is the nation, would be more prosperous as a whole if the whole of the taxation of the country were put upon land. But I question if anyone professing to hold that opinion could even *indicate* what he meant by putting the whole taxation of the country upon land. It would, no doubt, be tolerably clear sailing for him to point out that if everyone whose income was derived from anything other than agriculture ceased to have to pay taxes, those people would have more money to spend than they have now; but there his elucidation of the matter would have to end. Given the problem that, say, ninety millions of money has to be raised by taxation and that he is debarred from any other source of revenue except what he can get from the land, and he will find that he is confronted with an impassable barrier to success. The soil of itself will produce nothing valuable without the labour of man directly, or the employment on it of capital which

represents, as everyone knows, the stored up labour of former men.

If the State was the absolute owner of a large tract of land and nothing more, not one shilling could they draw from it until someone came to their assistance. The right of cultivating the soil for one's own benefit and the reasonable security of the enjoyment of that right, is the only thing that any Government has in its power to offer, or that any individual proprietor of land has to sell. For all the rest they either of them will have to depend entirely on how much they can make it worth the while of the cultivator to give them, out of the money he is enabled by this quiet and peaceable possession to earn for himself. It is easy to see that if individuals who have acquired this right are to have the power of parting with it to another individual for a consideration, then the ownership of land as apart from the cultivation of it is an established fact. For the sake of argument, however, I will suppose that this is not the case and that everyone who occupies, that is, who farms the land, ceases to have any interest in it as soon as he ceases to occupy it. In this case as soon as the occupier became unable or unwilling to cultivate the land he had any longer, he would surrender it and the State would have to find at once a new tenant willing to take it, able to cultivate it, and with sufficient means to enable him to pay for doing so. And if this failed to do so the revenue from that land

would cease at once. That is to say, the State would be thenceforth altogether dependent for its revenue on the convenience, or even the caprice of the cultivators of the soil, that is, on the will of one particular industry instead of depending on all the industries combined.

Let us, however, without at present going further into this question, turn our attention for awhile to facts as they are and see what is the effect produced by putting any tax on land. I will simplify matters by doing away with the distinction between the owner of land and the occupier, and look upon them as representing the same individual, for whichever pays the taxes to the State, the money to pay it with must be derived from the sale of something that is produced from the land by means of the labour or skill or capital of the person who cultivates it.

As far as the rest of the country is concerned, it is immaterial whether the owner of the land is himself the cultivator or whether he goes into partnership with someone else to cultivate it for him and give him a certain share of the profits. In either case any money taken away from the two by taxation diminishes the profits of the firm. And as the firm is a firm engaged in the production of food and the sale of that food to others, the imposition of any taxation is an impost on one particular branch of industry.

Now, as I said before, the soil left entirely to itself will produce nothing saleable, and therefore in taxing

the produce of the soil you are not taxing the soil itself but you are levying a fine on the capital and labour employed on the soil, and as it is quite optional for anyone to decide whether he will employ his capital or his labour in producing food or in producing something else which will yield him a profit, it will be seen that in proportion as you diminish by taxation the profits arising from the production of food, that is, from agriculture, in just so great a proportion do you take away the inducement to employ capital in the developing the resources of the land in preference to employing it in some other branch of industry, *unless you tax the other industries in the same proportion.*

It is a fact which no one will contradict that whatever may be the profit respectively to the cultivator there is no doubt that the application of a large amount of capital per acre to the land materially increases the gross produce either of meat or corn. Hence it follows that any legislation which makes the investment of capital in agriculture attractive, increases by so much the quantity of corn and meat produced in the country, and diminishes the necessity of the country buying corn or meat elsewhere, and that in proportion as a country levies taxes on the producers of food, and renders that industry unattractive, in such a proportion will they have to buy their food elsewhere instead of getting it at home for nothing.

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